Engineering Technology Systems Manual

Utah Department of Transportation

- Engineering/CADD Systems
- CADD Standards

ETS
Engineering Technology Systems

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Introduction

Purpose

The Engineering Technology Systems Manual contains all requirements to effectively utilize Computer Aided Design and Drafting (CADD) for production, delivery and processing of electronic projects for the Department. It includes all in-house hardware, software and configuration requirements. It identifies the tools, techniques, applications, standards and procedures that managers and producers of CADD data will use to produce quality products in a timely manner. Professional service administrators, project managers, consultants, in-house designers, and others will incorporate by reference the procedures defined in this manual into scopes and other contract documents for services.

Authority

Section 72-1-201, Utah Statutes

Title 72 of the Utah Statues, known as the Transportation Code, establishes the responsibilities of the State, Counties, and Municipalities for the planning and development of the transportation systems serving the people of Utah, with the objective of assuring development of an integrated, balanced statewide system. The Code's purpose is to protect the safety and general welfare of the people of the State and to preserve and improve all transportation facilities in Utah. Under Section 72-1-201, the Code sets forth the functions, powers, duties, rights, and responsibilities of the Department of Transportation to establish standards and procedures regarding technical details of administration of the state transportation systems.

The guidelines in this Engineering Technology Systems Manual represent minimum requirements that must be met for the development of UDOT CADD projects. While the requirements contained in this document provide a basis for uniform CADD practice for UDOT projects, precise rules that would apply to all possible situations that may arise are impossible to give. Situations may exist where these standards will not apply. If variances from the standards set forth in this Engineering Technology Systems Manual are necessary for a project, they must be approved in writing by the UDOT Project Manager and documented in the Project Journal file as defined herein.

The Engineering Technology Systems Manual is published as a complete revision to the April 1997 Computer-Aided Drafting and Design Standards Manual.

Scope

The Engineering Technology Systems Manual establishes production standards, procedures and support required for engineering projects. All in-house personnel producing engineering projects are required to use it. All contracts requiring the production of engineering data, incuding plans preparation, will include it by reference in the scope of services. The Engineering Technology Systems Manual will affect all offices of the Utah Department of Transportation and all consultants, contractors and others who utilize engineering CADD systems or engineering data produced by these systems.

Definitions

Engineering Data - Those digital files which support or represent the intent of the engineering design, or the engineering analysis.

CADD - (Acronym for *Computer Aided Design and Drafting)* The systems, software and methods used to analyze, design and represent transportation facilities graphically. CADD facilitates the presentation of *Engineering Data. Engineering Data* and *CADD* comprise the Department's *Engineering Technology.*

CADD Technical Support - The support of computer systems and software for engineering applications concerning their functionality and fitness for use. This includes: (a) statewide procurement of hardware, software and other applications, (b) software and systems development and integration, assessment, and testing, and (c) distribution, implementation and training. This is the highest level of support and is typically an ETS function or is provided by the systems or software developer.

CADD Operational Support - The support of computer systems and software concerned with the usage and application of such by a particular engineering discipline for a specific engineering task. This involves the development of procedures, user guides and handbooks for the application of these resources in their functional area for day-to-day operations. This is typically a discipline (Roadway Design, Structures, Surveying and Mapping, etc.) or Region function.

CADD TAC - (Acronym for Technical Advisory Committee) A committee led by the UDOT CADD Coordinator consisting of ETS staff, Region Technical Influencers, and Central office representatives charged to meet and work on statewide technical issues dealing with CADD systems, procedures, testing, implementation and operations. Central office representatives for Right of Way, Structures and Traffic and Safety are selected by management in the respective constituency.

Technical Influencer - Technical Influencers are assigned by the Region Pre-Construction Engineer while Technical Influencers in the Central office are assigned by the division manager. The

Technical Influencer is responsible for providing an operational CADD software environment for the entire Region or division including the core CADD software products and related programs that support Roadway, Structures, Construction, Location Survey, and Right of Way. Additional responsibilities are defined throughout this manual.

Technical Support Specialist - ISS support staff responsible for providing an operational CADD environment for the Region or the Central office. This includes: (1) the CADD hardware, communications and associated operating systems and (2) access control to engineering data.

ETS: Engineering Technology Systems Section responsible for procurement of CADD related software, the CADD QC/QA initiative, training, distribution of CADD standards, and other software development to further productivity.

UDOT CADD Coordinator - The IT Manager of ETS responsible for planning and programming of Engineering Support activities.

Organization

ETS, with input from the Regions, Central offices, and industry, will develop and maintain procedures and standards for the Department's CADD production and related activities. The Engineering Technology Systems Manual must be in compliance with Department policies, procedures and standards for information technology resources. These procedures and standards are organized into parts within the Engineering Technology Systems Manual. At present, the following parts are incorporated in the manual:

Part 1 **Engineering\CADD Systems:** Establishes production standards, procedures and support required for engineering projects.

Part 2 **CADD Standards:** Documents graphic and operational standards that pertain to MicroStation V8, the general project directory structure, and file naming requirements for design and sheet files.

Other forthcoming parts of the manual are:

Survey Standards: Documents survey standards for the collection, organization, and dissemination of project level survey data utilizing the Trimble and InRoads Survey softare.

CADD Requirements for Civil Design: Documents standards for using the InRoads civil design software including file and component naming conventions.

Project Workflow for CADD: A guide that associates CADD related activities and the creation of engineering data with the activities in the defined in the UDOT Design Process.

CADD Deliverable Requirements: Documents the requirements for compiling, securing and delivering project data for advertisment or archiving.

As parts or section are adopted in accordance with this procedure, they will be added to the manual.

Revisions And Additions

Engineering Technology Systems Manual holders are encouraged to submit comments and suggestions for improvements to the manual. To provide feedback, use the Feedback Form on the Engineering Technology Service website: www.dot.utah.gov/ets/.

This manual applies directly to two distinct functions, the *Support of CADD* and the *Use of CADD in Engineering*. Although the majority of proposed changes to the manual originates from these func-

tions, all proposed revisions and additions, either in draft or final form, shall be reviewed by all functions or offices affected by the manual.

This manual, in whole or in part, is subject to the Executive Review Process. However, this ***Intoduction*** has particular importance in the executive review and approval process inasmuch as its approval authorizes the development and implementation of the remaining parts and sections of the Engineering Technology Systems Manual. The remaining parts will be developed and approved by the UDOT CADD Coordinator with input from: (a) the Regions, (b) offices within the Central Office that may be affected, (c) the engineering community and (d) the construction industry, and/or (e) the Executive Review Process. The intent is to be able to make technical revisions to the manual in a timely manner. Substantive revisions that result in policy change will be coordinated with the Executive Committee.

ETS anticipates regular updates due to corrections, technology changes, and/or changes to process and workflow requirements. Notifications of revisions and additions will be distributed to registered holders of the Engineering Technology Systems Manual via e-mail. Register for this manual by submitting and e-mail address on the ETS Document Registration web page: www.dot.utah.gov/ets/.

Support of CADD

The Technical Influencers shall interface between the users and ETS to facilitate input, revisions and additions to the manual in the area of support. CADD support shall include procurement and installation of computer hardware and software, electronic data delivery, training and quality control. It shall be the Technical Influencer's responsibility to ensure that all offices affected by this manual are informed. The Technical Influencer shall forward user recommendations to the UDOT CADD Coordinator for consideration.

Use of CADD in Engineering

CADD users in the regions and central office are encouraged to hold regular CADD meetings to receive training and to make the Technical Influencer aware needed improvements. The Technical Influencer will review the comments from the users and present recommendations to the CADD TAC. Each engineering discipline utilizing CADD, each region and the central office shall be represented on the CADD TAC by knowledgeable and proficient CADD users. The purpose of this committees is to continually improve the CADD procedures, processes, and standards and to identify users' needs. End user input for revisions and additions to the Engineering Technology Systems Manual shall be processed through the CADD TAC.

Distribution

This document is available in electronic form as a PDF file on the ETS web page: www.dot.utah.gov/ets/. The PDF file may be printed and distributed freely.

Training

Training issues and opportunities are identified within the applicable sections.

Forms

Forms required for use with this manual are identified at the end of each section.

Part 1:

Engineering\CADD Systems

- Introduction
- Computer Systems
- Production Standards
- Production Procedures
- Electronic Data Delivery
- Support
- Software Development and Distribution
- Quality Assurance

ETS
Engineering Technology Systems

Section 1 **Introduction:** Describes and implements the Engineering\CADD Systems.

Section 2 **Computer Systems:** Establishes the requirements for procurement, maintenance and support of CADD systems and services within the Department.

Section 3 **Production Standards:** Defines the production standards used for UDOT CADD projects.

Section 4 **Production Procedures:** Establishes minimum requirements which must be met for the production of UDOT CADD projects in accordance with the UDOT Design Process.

Section 5 **Electronic Data Delivery:** Describes how electronic data is delivered, archived and made available to customers.

Section 6 **Support:** Defines the support structure and services, including CADD training, within the Department. Also defines applications and tools supported by the ETS.

Section 7 **Software Development and Distribution:** Defines how CADD software is developed, tested and distributed.

Section 8 **Quality Assurance:** Describes how Quality Assurance Reviews are to be used to improve CADD processes and products.

Section 1: Computer Systems

Purpose

This section establishes the minimum requirements for procurement, maintenance and technical support of the Department's Engineering/CADD hardware and software systems.

Scope

These requirements apply to all computer technology and services within the responsibility of the ETS Section and the Technical Support Specialists.

Definitions

CADD Hardware: The workstations, file servers, tape drives, CD-ROM, CD-ROM servers, printers, plotters and all other computer equipment used in the Department's production effort.

CADD Servers: A computer dedicated to the storage and management of UDOT Engineering / CADD data or the execution of specific production tasks, such as plotting.

CADD Software: Any software procured and supported by ETS. This includes but is not limited to software manufactured by Bentley Systems and Transoft Solutions.

CADD Systems: All of the CADD hardware and CADD software that support the CADD production effort.

CADD Workstation: A computer running CADD software used for the development of CADD drawings and documents.

Distributed Computer System: Any multi-user computer system that can operate independent of the Department's mainframe computer.

Engineering Data Services: A function or functions within the Department for handling and redistributing engineering and CADD data, including consolidation, packaging, archiving, and distribution of all data belonging to a project.

UDOT CADD Software: The CADD software and resources developed, maintained and/or distributed by ETS. At present this is limited to the Project Setup Utility.

References

Information Technology Resource Standards (Under Development)

Engineering Technology Resource Standards (Under Development)

Cadd Planning and Budgeting

ETS will annually review the status of the statewide CADD program and if appropriate submit a budget issue to support the Department's CADD production efforts. With involvement and direction from executive management, the budget issue shall address statewide CADD procurement needs for equipment, equipment maintenance, or other issues of statewide significance. ETS will solicit input from the Technical Influencer during formulation of the issue. The CADD budget issue will be prepared in accordance with the UDOT budget preparation instructions and submitted as part of the agency's budget package.

Asset Selection / Standards Adoption

ETS, with assistance from the Technical Influencer, shall test and evaluate computer hardware, software, and other components of the CADD system. Adoption of new versions of standard CADD products is subject to the hardware and software selection procedures below.

Hardware

This section addresses the mechanism for modification of the Department's CADD hardware standards to insure consistency with current technology.

Procedure For Adoption As A Hardware Standard:

1) The Department's CADD hardware standards are subject to modification. Department personnel may request consideration of new computer hardware by submitting a written request for evaluation, including justification, to the UDOT CADD Coordinator or a Technical Influencer.
2) The UDOT CADD Coordinator will review the request for evaluation. If justification is sufficient to warrant further investigation, the CADD Coordinator will assign an evaluation team to conduct a comprehensive evaluation.
3) The evaluation team will investigate the proposed hardware, prepare specifications if warranted, and prepare a written report detailing their findings. The proposed hardware must be tested for compatibility with CADD software standards. The report will be produced in a format suitable for presentation of all tests and test results.

4) The UDOT CADD Coordinator will arrange a joint meeting with the Technical Influencer to review the written report. Consensus by the group is required for modification of the CADD hardware standards.
5) The UDOT CADD Coordinator will submit a written request to the ISS Manager to effect the changes.

Software

Evaluation Process:

1) Requests for modification to the CADD Information Technology Resource Standards must be made through the UDOT CADD Coordinator.
2) Requests will be considered by the UDOT CADD Coordinator and the a Technical Influencer and approved or referred to an evaluation team for technical analysis.
3) The team will determine an appropriate analysis process and document the evaluation. The completed evaluation will be submitted in writing to the UDOT CADD Coordinator.
4) The UDOT CADD Coordinator will submit a written request to the ISS Manager to effect the changes.

Workstation and Server Configuration

CADD workstations and servers shall adhere to the following minimum standards.

Workstation

Minimum workstation requirements are based on software vendor recommendations and ETS hardware performance evaluations. Minimum workstation requirements are as follows:

Intel Pentium-based or AMD Athlon-based PC or workstation (500mHz min.)

Operaating System: Microsoft Windows 2000, Windows XP, or Windows NT (SP6)

Memory: 256 MB (Vendor recommends 64 MB should be available for each session)

Hard Disk: 20GB (200 MB min free disk space)

Graphics Card: Most industry-standard graphics cards supported.

Software Requirements: Microsoft Internet Explorer 5 or better

Cipher Strength: 128-bit

Configuration of CADD workstations is established jointly by ETS, Region Technical Influencer and Technical Support Specialists.

Server and Network

This paragraph will be defined by Bob G and cover the requirements for drive designations including drive mappings, system directory structure, plotting servers and system printers and drivers.

Data Backup And Recovery

The data on all UDOT CADD servers and workstations shall be regularly backed up according to the schedules specified herein. Bootable system media shall be produced and tested at the time of a change in system software and kept with both the on-site and off-site backups.

Server Daily Backup

The Technical Support Specialist will ensure that all modified files on all CADD Servers are backed up at the close of each business day.

Server Biweekly Full Backup

The Technical Support Specialists will ensure that full backups of all CADD Servers occur at least once every two weeks. The following requirements shall apply:

1) Two copies of full backups shall be produced.
2) Biweekly full backups shall include all system software, application software and user data files.
3) One copy of the backup media must be kept at a secure off-site location.
4) Each Biweekly backup shall be retained for a minimum of six months.
5) The biweekly backups done on the dates nearest to January 1 and July 1 shall be kept indefinitely.
6) An electronic journal shall be maintained of the backup activities. The journal shall include chronology, media locations, media types, responsible parties, and disposition.

Workstation Backups

Production data should not reside on workstations. Backups are not performed on workstations except on an as-needed, as requested basis.

Engineering/CADD Data Retention

Engineering/CADD project data will be retained permanently by ETS.

1) Media: The retention media currently used is a network hard drive along with tape backups.
2) Verification of Data Integrity: The integrity of the retention media shall be verified by Central office ISS staff.

Security

Security of CADD hardware resources shall adhere to the policy ***Data Processing Technology Acceptable Use (***UDOT 05A-1). Security of Engineering/CADD data shall conform to Region or Central office policies developed by the respective Technical Influencer and Technical Support Specialist.

Inventory

The UDOT CADD Coordinator shall maintain a system of accounting for all centralized CADD purchases to be used in subsequent budgeting activities, maintenance agreements, and general CADD resource reporting.

Hardware

ISS in conjunction with the Region Technical Support Specialists shall maintain a perpetual electronic inventory of all CADD equipment according to the current ISS policy for equipment inventory.

Software

ETS shall maintain a perpetual electronic inventory of all CADD software including:

- Vendor / Supplier
- Software Title
- Serial / Registration / License Number
- Version
- Purchase Order Number
- Purchase Order Date
- License / Maintenance Start Date
- License / Maintenance Expiration Date
- Host Computer Name
- Status (Active or Replaced / Upgraded)
- Serial / Registration / License Number of Successor
- Date of Succession

ETS may use the services of a Value Added Reseller (VAR) to maintain the CADD software inventory.

File Management System

The Department is currently evaluating the use of proprietary software to use as a file management system. Use of the project directory structure defined in *Part 2: CADD Standards* will be required until a file management system is implemented.

Plotting Systems

Most industry-standard output devices are supported for the production of hardcopy documents. ETS has developed several plotting criteria for InRoads based on the capabilities of the HP8100 series printers. See *Server and Network Requirements* for digital plan room hardware and software requirements.

Scanning Systems

Scanning systems capable of providing the resolution and file format requirements compliant with the standards found in this manual shall be used for the scanning of hardcopy documents into electronic formats.

Section 2: Production Standards

Purpose

This section establishes the critical CADD requirements (Production Standards) used in the production of engineering projects for the Department in compliance with the procedures of each professional discipline of the Department. These professional disciplines include Surveying and Mapping, Right of Way Mapping, Environmental Management, Roadway Design, Structures Design, Traffic & Safety and Construction.

Scope

These Production Standards apply to all CADD projects produced by and for the Department in addition to the criteria, standards and procedures of the various disciplines included in:

- *Design Process Manual*
- *Roadway Design Manual of Instruction*
- *Right of Way Design Manual of Instruction*
- *UDOT Standard Drawings*
- *Mapping & Aerial Photography*
- *UDOT Design and Detailing Standards.*
- *Construction Manual of Instruction*

Definitions

The following definitions relate to electronic generated project data and deliverables. For the definition of other common terms and acronyms used in the Engineering Technology Systems Manual, refer to the *Introduction*.

CADD Standards: The Department's compilation of CADD procedures and settings to ensure efficient use of the system and consistent project output and efficient development of electronic deliveries for projects.

CADD Requirements for Civil Design: The Department's compilation of workflows, requirements, and settings for the civil design software.

Project Workflow for CADD: Describes CADD workflows and activities as they relate to the Department's *Design Process Manual*.

CADD Deliverable Requirements: Requirements for file types, formats, electronic deliveries, etc. for CADD projects submitted to the Department by in house and Consultant designers ir any organization affliliated with as-builts.

CADD Production Standards: Established specific requirements to achieve a desired level of quality or outcome, which impacts current or future operations and user applications. This Chapter is the CADD Production Standards.

Electronic Journal: Electronic file(s) in an ASCII format that documents the history of the development, the correspondence and decisions made, the methodology used, and other descriptive information about the project. The Journal includes the complete Index of all electronic files referenced or generated for the project which details the work contained, the applications and methods used, and other information that will give future users of the files insight about the project data. The Electronic Journal is of two types – the component or discipline specific journal and the overall or project journal applicable to the total project.

Electronic Project: All electronic files, reports, documents, databases, images and other electronic information representing a complete contract document package for a UDOT construction project. Sometimes called a CADD project.

Engineering Data: Those electronic files that represent the critical geometric and quantitative controls or other engineering calculations supporting the graphical representation of a project.

Graphics Design File: An electronic file that conforms to MicroStation graphics format.

Project Component: All electronic files that represent and support a delivery by a discipline as part of a project.

Project Component Directory: The data structure and organization of electronic files on storage media. This directory is the highest branch in a file directory structure that contains a delivery from a discipline.

Project Directory: The parent directory containing all project component directories and ancillary data.

Project Index File: A text (ASCII) file that lists and briefly describes each file contained in a computer generated delivery. The Project Index file is part of the Electronic Journal.

Supporting CADD Files: Any files, including MicroStation Resource Files (such as fonts, line styles, pen tables, cell libraries, etc.) that are required to reproduce the sheet images.

Department Resource Standards

In addition to the software listed below, UDOT uses other propietary software to help in the design and maintenance of project data. Included among them are AutoTurn and GuideSign (Transoft Solutions) and various structures design and analysis programs.

Graphics Software.

The approved and supported drafting software of the Department is MicroStation V8®. All engineering design graphics files shall be delivered in the MicroStation V8 format.

Plotting Software

The approved and supported plotting software of the Department is InterPlot®. All engineering sheet files shall be organized into an InterPlot Plot Set (*.ips file) to be used in the Department's Digital Plan Room.

Civil Engineering Software

The principal civil engineering software used and supported by the Department is InRoads®. Other approved survey/engineering software standards includes Trimble Office, InRoads Survey, InRoads Bridge, and InRoads Storm & Sanitary.

The Department does not restrict the use of other software packages by the private sector, but requires the delivery to adhere to the standards and formats as specified herein.

Project Directory Structure

All projects shall have a standard project directory structure. Data from each discipline shall be maintained in individual sub-directories under the project directory. The UDOT standard project directory is defined in *"Project Directory and File Names"* on page 2-61.

UDOT has developed software to expedite the creation of the UDOT standard project directory. See *"UDOT CADD Software"* on page 2-49 for details. For questions on using this software contact ETS at 965-4038.

Cadd Resource Files

All projects will utilize the standard supporting CADD resource files distributed in the CADD Standards Folder. The version used shall be current with the version available at the time of project execution. Exceptions to the standard supporting CADD resource files, or user customization, shall be approved by the Department's Project Manager and shall be documented and delivered as part of the project.

File Naming Conventions

Files shall be named in accordance with the naming conventions in *"Project Directory and File Names"* on page 2-61.

Delivery Components

See *CADD Deliverable Requirements* (under development) for deliverable requirements.

Engineering Data

The Department requires that all engineering data files used or produced in conjunction with a project be delivered in the native format of the system used to produce it, in addition to the standard formats required in this manual.

Geometric Controls

Files will be created representing the controlling geometrics of the project. These files will contain the points, curves, spirals, chains, alignments, profiles, cross-sections and other critical geometric data necessary for the construction of the project. These files will be in addition to the native format files referenced above.

These geometric control files will be delivered as ASCII text files that are machine readable by the Department's principle design systems. *CADD Requirements for Civil Design* (under development) will define the acceptable naming conventions and file formats for these files.

Quantity Data.

CADD Requirements for Civil Design (under development) will define the acceptable naming conventions and file formats for these files.

Graphics Design Files

Graphics design files shall be prepared using the file naming conventions, symbology standards and software resources defined in *Part 2:CADD Standards*.

Sheet Files

Sheet files are graphics design files used specifically to produce the plots. Sheet files are generated from MicroStation, and produced to scale.

Paper Plots

Standards for paper plots are detailed in each discipline's procedure(s).

Electronic Journal

An electronic journal will be produced in accordance with *"Project Journal Files"* on page 2-93. The electronic journal will be delivered with the project.

Cadd Standards

Part 2: of this Engineering Technology Systems Manual is considered the *CADD Standards*.

Part 2:CADD Standards contains:

- Drawing standards for level symbology, including required fonts, level, color, weight, and linestyles for discipline specific files. Preferences for non-mandatory symbology are also provided
- References to supporting resources, such as font and line-styles libraries, cell libraries, seed files, color table, databases, and configurations for UDOT supported engineering software.
- Electronic data production and delivery specifics, such as directory structure requirements, file formats and file naming requirements
- References to supporting MicroStation applications and drafting aids
- References to documented help, operating instructions, handbooks and guidelines

Each professional discipline at UDOT may define additional CADD requirements.

Section 3: Production Procedures

Purpose

This section provides the critical steps for a consistent and efficient CADD production process.

Scope

These procedures are applicable to the computer-based CADD applications utilized by and for the Department in the production process. They are intended to complement and support the policies, procedures and standards of the Department.

Accountability

This procedure does not exempt the professional from performing responsible engineering, surveying and mapping or architecture. The policies and procedures of the Department and appropriate professional practice take precedence when providing professional services for the Department. The professional shall have final responsibility for the accuracy of all input and output of computer-based applications.

Definitions

CADD Production: The development of Electronic Projects utilizing computer-based applications, software and discipline processes.

Project Manager: The person charged with the responsibility for ensuring the scope of work for a project is satisfied. This could include discipline specific personnel. This person is responsible for receipt, acknowledgment, validation and acceptance of the project data.

Udot Cadd Resources

In the interest of consistency and efficiency, the Department has established the Engineering Technology Systems Manual, which is upgraded and made available periodically, along with UDOT CADD software and other resources to the entire UDOT CADD community and consultants. This part of the manual provides the standards that are critical to the production and delivery of quality electronic

projects that satisfy both the immediate and future customers of CADD data. It is the user's responsibility to acquire the current version of UDOT CADD software and resources prior to beginning CADD production.

Producing The Electronic Project

All electronic projects for UDOT shall be created recognizing the requirements as described in flowchart ***Figure 4-1.***

We will come up with a flowchart for electronic projects and put it here!

Standard Project Directory Structure

The Standard Project Directory Structure, as defined in *Part 2:CADD Standards*, shall be used for all UDOT Electronic Projects. All files will be placed in their proper location in this directory structure as they are generated.

Electronic Journal and Index

Each discipline working on CADD projects shall document the decisions made, methods used, and actions taken on the CADD project as they occur. This will be done in the form of electronic documentation, comprising the Journal for the project. Design variations and exceptions can be thoroughly documented as part of the Electronic Journal. The Professional of Record or Project Manager is responsible for the overall electronic journal for the project.

As a component of the Journal, every electronic file generated and included in the electronic delivery shall be indexed. This index will contain sufficient descriptive information so a successor or customer of the data will understand the file's contents and other data necessary to efficiently make use of the data. Index files shall be kept current during the production process.

The format of the project Journal and index file shall conform to the requirements in the *Part 2:CADD Standards*.

Content and Format of Imagery

The visual (graphical) representation of electronic CADD data is critical for the proper communication of the professional's intent. Roadway, Structures Design, Right-of Way Mapping and other disciplines have standards for plans and maps, which establish the content and format of imagery for files and hardcopy plots. Producers of electronic projects must refer to these procedures for this information.

Quality Control

Quality Control shall be performed as the work is being done. Every user must develop and/or follow a QC Plan during the development of electronic projects. Work shall be checked for compliance with the *Part 2:CADD Standards*, ***Acceptable Standards for Project Design (UDOT 08-2)***, the ***Standard Specifications***, and other applicable Department policies and procedures before finalizing the electronic project files.

Finalizing & Delivering Electronic Projects

Electronic projects must be properly packaged for delivery as defined in ***CADD Deliverable Requirements*** (Currently under development). This function requires compiling and organizing the data, quality controls, packaging and delivery.

Compile and Organize the Data

The Project Manager or Principal Consultant is responsible for assembling the required delivery for the Department according to this manual.

Packaging the Delivery.

When the data is selected for a delivery, it will be integrated under a single project directory structure.

The Project Manager or Principal Consultant is responsible for proper packaging of the electronic project data in accordance with this manual.

Final Quality Control

The Project Manager or Principal Consultant, working with the various discipline professionals, will ensure the content, completeness, usability and proper packaging of all electronic files.

The Final Project Delivery

The Project Manager or Principal Consultant will be responsible for collecting the contract deliverables. After verification of project data is complete, CD-ROM(s) shall be produced in accordance with *Part 2:CADD Standards* and delivered to the Project Manager, along with other contract deliverables.

Section 4: Electronic Data Delivery

Purpose

This section identifies the minimum requirements and functions necessary for the delivery and disposition of electronic data.

Scope

This Chapter covers the UDOT functions to receive, authenticate, integrate, package, and distribute electronic data.

Definitions

Data Exchange: This is the data that is exchanged during the design process between different organizations or work groups.

Archival Data Set: This is a data set of all the electronic data for a project.

Contract Package: The electronic bid package

Receipt And Acceptance Of Electronic Data

The Project Manager is responsible for ensuring that the terms of the scope of services have been met. This includes ensuring that the standards set forth in *Part 2:CADD Standards* and quality control procedures were followed during production of the electronic data.

Receipt Of Data.

The Project Manager will receive electronic data under letter of transmittal.

Acknowledgment

The Project Manager will provide a receipt of transmittal to the data producer. This receipt does not infer the electronic delivery is acceptable, or meets all of the conditions defined in this manual or other agreements.

Acceptance

The Project Manager ensures that the electronic delivery is checked for completeness and meets the terms, conditions and requirements outlined in this manual. Once the electronic delivery has been determined to be in compliance, including project consolidation, a record of acceptance will be made and the data will be transmitted to the Advertising Section. If the electronic delivery is rejected, then the provider will be notified.

Data Packaging, Archival, And Distribution

The Project Manager will coordinate with the Advertising Section regarding the contract packaging requirements and will transmit the project data in the form of an advertising package to the Advertising Section. The Advertising Section is responsible for the handling, packaging, and distribution of the Engineering\CADD data for a delivery or a letting.

Archive And Security Of Data

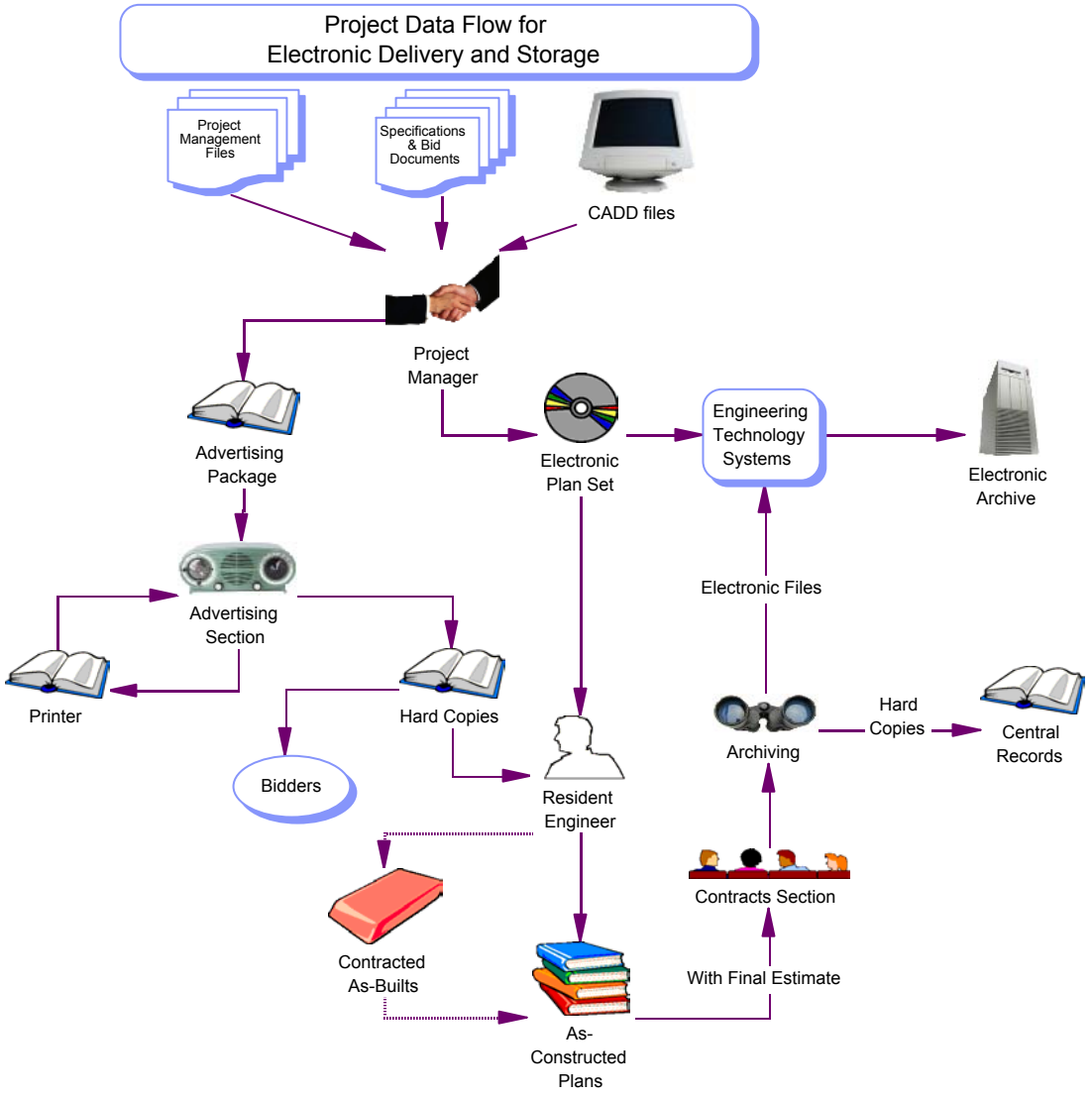
ETS is responsible for archiving and re-distributing all electronic data belonging to a project. ETS will insure prescribed safeguards for the data have been. The archival package or data set includes all electronic data available for a project.

Publication and Distribution

The Advertising Section is responsible for publication and distribution of electronic data in accordance with procedures or requests, including but not limited to publishing electronic data to different media, CD-ROM publication and Internet/Intranet posting.

Figure 5.1 shows the flow of data from design through construction and the parties responsible for maintaining the project data. All electronic data to be archived is to be delivered to ETS.

Figure 5.1


Project Data Flow for
Electronic Delivery and Storage
Project Management Files
Specifications & Bid Documents
CADD files
Project Manager
Advertising Package
Electronic Plan Set
Engineering Technology Systems
Electronic Archive
Advertising Section
Electronic Files
Printer
Hard Copies
Archiving
Hard Copies
Central Records
Bidders
Resident Engineer
Contracts Section
Contracted As-Builts
With Final Estimate
As-Constructed Plans

Section 5: Support

Purpose

This section establishes the primary components of the Engineering CADD support structure, including the statewide training component.

Scope

This procedure establishes the CADD-related support roles and responsibilities of the ETS Section, the Region CADD support function, and the CADD Technical Advisory Committee (CADD TAC). It establishes the hierarchy of support from the peer level to the statewide level.

The UDOT supports all CADD software and hardware used for in-house production. Consultant support is limited to UDOT developed software, interfaces, and configurations.

Components Of Cadd Support

The primary components of the engineering CADD support structure include:

Systems Support: Test, select, procure, and maintain CADD hardware and software necessary to support the technology in a networked environment.

Operational Support: Develop, enhance, and support the software application used by the engineering community to perform CADD production. This includes providing the discipline-specific tools to perform tasks more easily and efficiently.

Training: Provide current technical materials and education for both systems and operations to enhance and maintain skills.

Hierarchy Of Cadd Support

CADD support is handled at different levels in the CADD statewide support structure. Users will seek support at the lowest level before escalating a support request to the next level. The following will address how support is handled for each component.

Systems Support

The first level of systems support is the region or central office division level. Support responsibilities within the region are distributed according to the region organizational structure. The Technical Influencer is the primary liaison with the ETS Section for addressing CADD systems issues. Region or Division CADD systems support activities include, but are not limited to, the following:

1) Assist with identifying the users' CADD hardware and software needs
2) Distribute and setup CADD equipment and software
3) Provide input for the statewide CADD budget
4) Recommend CADD network needs and improvements
5) Provide day-to-day technical support of the computer hardware and software systems used in the region.

The second level of systems support is the ETS Section. The support responsibilities of the ETS include:

1) Manage the statewide engineering CADD budget
2) Procure CADD hardware and software for networks and users
3) Assist the Technical Influencers in the distribution and setup of CADD software.
4) Provide inventory management associated with the statewide CADD hardware and software
5) Manage statewide vendor contracts and maintenance services for CADD systems.
6) Provide day-to-day technical support of the computer hardware systems used in CADD statewide.

Operational Support

The first level of operational support is peer support within the individual disciplines.

The second level of operational support is the Technical Influencer.Technical Influencers represent their region and discipline, and are responsible to communicate and resolve support issues of local and statewide interest.

The third level of operational support is the ETS Section. ETS is responsible for UDOT application development, enhancements, and support. ETS will provide support assistance or will contract for required services as necessary. ETS will coordinate all support requests including those to CADD software vendors.

Training

Each region is responsible for coordinating all CADD training within the region. ETS manages and coordinates the statewide CADD training program for UDOT personnel. The Region Technical Influ-

encer is the primary liaison for coordinating any training to be provided through the statewide CADD training contracts administered by ETS.

ETS will coordinate training in the following areas:

1) Hardware and software setup, maintenance and support
2) Application software packages (i.e., core CADD software)
3) Development tools and applications
4) CADD production procedures.

Section 6: Software Development and Distribution

Purpose

The purpose of this section is to define how CADD software is developed, tested and distributed.

Scope

This chapter applies to all CADD software products procured or developed to produce projects for the Department. This procedure covers the steps used to develop, test, approve and distribute CADD software products supported by the Department. Development of CADD software used to produce projects for the Department is the responsibility of the ETS Section and other designated offices.

Definitions

Alpha Testing: Initial testing of CADD software products or enhancements by the development staff and testing by the support staff outside of the development environment.

Beta Testing: Secondary testing of CADD software products performed in a production environment by end-users.

Beta Testing Coordinator: The individual responsible for facilitating the beta testing of CADD software.

CADD Software: CADD products and applications used in the production of electronic CADD projects, including programs, documentation, and training aids.

Development

Development encompasses new CADD software applications, enhancements to existing CADD software (added features), and the maintenance (bug fixes) of CADD software. Development is based upon need identification and may include the purchase of commercial software when appropriate. The UDOT CADD Coordinator shall approve the development or acquisition of any new CADD software for the Department.

Needs Identification

CADD software needs are communicated to the ETS by user requests or by the CADD Technical Advisory Committee. The ETS Section's Technical Suppport Request Log is used by the ETS to track bugs and identify needs for enhancement in existing CADD software, and to identify need for acquisition of new CADD software. Development requests are compiled by ETS, reviewed and prioritized by the CADD TAC, and a recommendation is made to the ETS for further action. If development or acquisition is approved, the CADD TAC will work with ETS to further identify requirements.

Specifications

CADD software development or acquisition will be based on written specifications and approved by ETS.

Development or Acquisition

The ETS, with input from the CADD TAC and Technical Influencers, will decide whether to develop CADD software in-house, contract for development services, or purchase a CADD software commodity. ETS will keep the user community informed as to the status (including training and implementation schedules) of major CADD development projects of statewide interest.

Software Testing

ETS, or the designated office, performs alpha testing of CADD software products during software development as required. Beta testing is to be performed prior to the general release of CADD software.

Beta Testing

When alpha testing demonstrates CADD software to be in good working order for the features intended for the release version, the software will be beta tested by production users prior to release. There are several activities involved in the beta testing cycle. The "beta testing coordinator," from ETS or the designated office, will facilitate these activities.

The beta testing of CADD software products for production by any of the Department's disciplines shall only be initialized following review and approval by the CADD TAC and the local Technical Influencer.

The request for approval to proceed with beta testing, based on the TAC's recommendation, will be initialized by the UDOT CADD Coordinator. Steps defined in this procedure for beta testing may not begin until such approval has been granted.

Beta Testing Coordinator

Each CADD product shall have a primary support contact assigned by the ETS. This person, or their delegate, will serve as the beta testing coordinator and will be responsible for:

1) **Participating as an alpha tester for the developer**

   The beta testing coordinator shall participate in alpha testing of the CADD software. The beta testing coordinator shall participate in discussions and review of alpha test results with the developer and other support staff members to determine the readiness of the product for beta testing.

2) **Seeking approval to proceed with beta testing**

   Formal contact shall be made by the beta testing coordinator with the appropriate TAC for review of the alpha test reports. The TAC may recommend and / or approve additional alpha testing, or beta testing. The TAC recommendation shall be made in writing to the beta testing coordinator.

3) **Coordinating the production of preliminary documentation**

   The beta testing coordinator will make available any necessary documentation required to support the beta testing.

4) **Coordinating the identification of the beta testers**

   The beta testing coordinator will solicit testers from the UDOT and the consultant user community, as appropriate. The beta testing coordinator will also consult with the Region Technical Influencers regarding recommendations for beta testers. An initial list of beta test participants will be proposed by the beta testing coordinator. The appropriate TAC(s) will review and modify the list as necessary. The beta testing coordinator will finalize, publish and maintain the list as testers are added or deleted.

5) **Beta Testing Orientation / Training**

   If necessary, the beta testing coordinator will host an orientation / training session for the beta testers to acquaint them with the software and other issues relevant to the beta testing process, such as reporting test results, beta software updates, and additional training that may be required.

6) **Testing Process and Reporting**

The beta testing coordinator will work with the testers and members of the development staff to define the testing process and the reporting method.

7) **Notification and Distribution to Testers**

Testers are notified by the beta testing coordinator that materials are ready for distribution. The beta testing coordinator will make the materials available to the Technical Influencers under cover letter of the UDOT CADD Coordinator. The Technical Influencer shall provide written notification to the beta testing coordinator that materials were received, and made available to the testers.

8) **Beta Software Updates**

The beta testing coordinator will make the latest version of the testing materials available to the Technical Influencers. A supplemental cover letter that contains a summary of the changes will be prepared by the beta testing coordinator and included with each distribution. The Technical Influencer shall provide written notification to the beta testing coordinator that materials were received, and made available to the testers.

9) **User Documentation**

The beta testing coordinator will ensure that user documentation is prepared in accordance with the functionality of the software. Review of documentation will be done as part of the beta testing process.

10) **Final Beta Test Report**

The beta testing coordinator will compile the results into a report and make it available to the TAC(s).

TAC Review and Recommendation

New software or changes to existing software will not be placed in production until the CADD TAC have reviewed the final beta test report and recommended the software for distribution. The CADD TAC will make a written recommendation to the UDOT CADD Coordinator for release of the product.

Cadd Product Approval

Approval to distribute CADD products comes from the UDOT CADD Coordinator via memo. This memo approves the software for general distribution to production users, and represents the final step in the development process.

Cadd Product Distribution

If approved, the TAC may make recommendations concerning the method of user distribution to be employed for a CADD product. Consideration of such distribution requests will be made at such time as the beta coordinator consults with the Technical Influencers in the Regions and Central Office to determine the best method for software distribution. All CADD product distribution will be done as follows:

1) Distribution will be made to the Technical Influencers who will be responsible for local distribution.
2) Written notice will be made to the Technical Influencer under signature from the UDOT CADD Coordinator. A copy of this notice will be sent to the TAC(s) and the beta testing coordinator.
3) The written notice will contain a place for the Technical Influencer to sign, acknowledging receipt of the software. A copy of the signed document will be sent back to ETS by mail or fax.

Section 7: Quality Assurance

Purpose

This procedure establishes the basis for Quality Assurance (QA) monitoring in the Region CADD functions. It also provides the areas of responsibility, frequency of monitoring and reporting methods.

The objective of QA is the continual improvement of the CADD process, which provides both user and customer satisfaction.

Authority

Section 72-1-201, Utah Statutes states that the Department shall ensure quality and monitor implementation of policies and procedures.

Scope

Each central office function has the responsibility of monitoring the implementation of policies, procedures and standards established for their particular processes. The Engineering Technology Systems Manual procedures and required standards apply to all CADD functions and will be monitored in accordance with these procedures by the ETS Section.

Definitions

Quality Assurance (QA): The planned, coordinated and continued activities performed to measure processes against predetermined critical requirements.

Quality Control (QC): The planned, integrated activities performed during work processes to ensure completeness, accuracy, proper decision making, and conformance with all other valid requirements.

Monitoring Plan: A QA work plan for CADD developed with Region input that identifies what, where, when and how monitoring, reporting, tracking and follow up are to be performed.

Critical Area: Those steps in the CADD process where significant problems may be introduced unless the Engineering/CADD standards are followed.

Critical Requirement: A decision, standard or process operation that will substantially and negatively affect the quality of the product or results if omitted or not performed to the expected level.

Compliance Indicator: Evidence that the critical requirements which are being applied are producing the desired result.

QA Monitoring Plan

The ETS Quality Assurance Monitoring Plan identifies the critical areas of CADD to be monitored, critical requirements and the criteria to measure process compliance. Compliance indicators will be used by ETS to determine how well the process is performing.

The monitoring plan provides the method for monitoring CADD processes, the frequency of team visits, the method for reporting and sharing monitored results with the regions, and the method for tracking and eliminating non-compliance issues.

The plan covers the major production areas of CADD, but users are reminded that quality CADD production is the result of doing many individual computer based activities correctly and in accordance with the current criteria and standards.

Accountability

The ETS Section issues the Engineering Technology Systems Manual and application software with operating instructions so that all CADD production will be based on predetermined requirements. Input on all of these requirements is solicited from the user communities, especially from the CADD TAC.

Region production units shall follow the discipline specific procedures for preparing plans and maps, and the Engineering Technology Systems Manual procedures and standards in the preparation of all projects and associated documents. Each region shall establish quality compliance indicators for all projects and monitor performance and compliance using those indicators.

Consultants are agents of the Department and are responsible for the quality of projects they prepare. They shall comply with the Engineering Technology Systems Manual requirements, and will perform quality control activities to ensure the completeness and accuracy of services performed for the Department.

QA Reviews

A CADD Quality Assurance review will be conducted in each Region a minimum of once every two years. The ETS Section will coordinate these reviews with the Region Secretary. These reviews will be for the purpose of measuring compliance with the critical requirements as outlined in the annual ETS Quality Assurance Monitoring Plan.

Part 2:

CADD Standards

- Introduction
- UDOT CADD Software
- MicroStation Resource and Support Files
- Project Directory & File Names
- CADD Standard Symbology
- Project Journal Files

ETS
Engineering Technology Systems

Section 1: Introduction

Purpose

The electronic files created during the process of developing a Computer Aided Design and Drafting (CADD) project for UDOT are to be shared and referenced by many different individuals and must satisfy various needs. The electronic files must be usable in a format that most, if not all, parties can access. Therefore, CADD processes must be established for disciplines that share in the CADD development workflow. This part of the Engineering Technology Systems Manual outlines the required standards, conventions and formats necessary to provide the most usable CADD data set to the potential customers of the CADD data, while providing the producer/developer of the CADD data information necessary to accomplish the task.

Scope

The material presented within this part will be monitored as a critical requirement under the ETS Quality Assurance Plan. Refer to *"Quality Assurance"* on page 1-41 for more information on the QC/QA plan or contact ETS directly. This part provides the requirements to produce electronic CADD files according to UDOT CADD standards in conjunction with UDOT CADD software.

This manual documents graphic and operational standards that pertain to MicroStation V8 and the general project file structure. This part is designed to be used in conjuction with other parts of this manual that define civil data standards, integration of CADD in the design process, and CADD deliverable requirements.

Distribution

This document, along with the other ETS documents, is available in PDF format on the UDOT Engineering Technology Systems (ETS) Internet Website: www.dot.utah.gov/ets/.

For questions or comments that are not addressed at the website, please contact the ETS office:

Utah Department of Transportation
Engineering Technology Systems
4501 South 2700 West
Salt Lake City, UT 84119
Telephone (801) 965-4662
FAX Number (801) 965-4604

Procedure for Revisions and Updates

See *"Introduction"* on page I-iii for the policy on revisions and updates.

Section 2:
UDOT CADD Software

General

UDOT CADD Software consists of proprietary software and the CADD Utilities program developed by ETS. The CADD Utilities program assists in the creation and maintenance of the UDOT project Cadd Workspace, the project directory and file system, and project maintenance issues. This program is upgraded on an as-needed basis. Updates and fixes are made available on the Region servers and from the ETS website. Notification of new versions and updates are provided on the ETS website and through e-mail to registered users of the Engineering Technology Systems Manual. Consultants and Contractors may contact ETS for support on these utilities.

Proprietary programs such as MicroStation V8 and InRoads must be purchased through an authorized Bentley sales office. Updates and fixes for these programs will be distributed to UDOT by the ETS staff. Consultants and Contractors will be responsible for purchasing and maintaining this software through appropriate vendor and company support representatives.

Distribution

Notification for statewide distribution of major software upgrades for UDOT employees will be made to Technical Influencers. ETS staff will be responsible for software distribution, installation or upgrades on the Region servers and all Region workstations. Critical software updates may be distributed to Region Technical Influencers on an as needed basis for required plans production.

Consultants and Contractors can acquire UDOT CADD Software, fixes, and upgrades from ETS directly or from the ETS website. For proprietary software, Consultants and Contractors must contact their respective sales and support representatives.

Support

If support is needed for the CADD Utilities program, UDOT employees will first obtain help from their Technical Influencer. The UDOT CADD support structure and hierarchy is described under the section *"Support"* on page 1-31. Consultants can contact the ETS office at (801) 965-4038.

Supported Products

The Core CADD Products used and supported by UDOT are:

MicroStation V8, InRoads, InRoads Storm & Sanitary, InRoads Survey, and InRoads Bridge from Bentley Systems, Inc.

Other software used and supported by UDOT are:

InterPlot from Bentley Systems, Inc., Trimble Office from Trimble, Inc.

The afore mentioned products are commercial software for which UDOT purchases a license for use. The Utah Department of Transportation makes no warranty, expressed or implied, as to the documentation, function, or performance of these or other UDOT developed programs described within this document.

Applications

- CADD Utilities program - (Assists in the configuration of UDOT standard MicroStation cell libraries, font and custom linestyle resource files, seed files, and UDOT project workspace variables)

Translating Files From a Non-Microstation Format to Microstation Format

UDOT requires the MicroStation V8 *.dgn format for the delivery of all graphics design files. The Consultant/Contractor is solely responsible for any translation required to convert non-MicroStation V8 graphics files to MicroStation V8 design file format. All translated design files shall conform to the standards adopted by the Department for electronic plans in this and other applicable standards manuals.

Section 3: Microstation Resource and Support Files

Fonts

MicroStation font resource files are binary files created from font cells, TrueType, Postscript, or AutoCAD shape fonts. MicroStation will read multiple font resource files according to the paths set by the MS_SYMBRSC configuration variable in the selected workspace. However, within MicroStation they are compiled into a list of all the fonts from all the resource files that were found. If one file contains a font with the same number assigned as another font resource file, the user will see the last one located. Also, UDOT has added to MicroStation's delivered fonts. For this reason UDOT has named their font resource file "udotfont.rsc". The Project Setup Utility will copy this file into the *drive:\Project\Resources\Styles* directory.

Standard practices for utilizing text include the following:

- Use text nodes in lieu of stacking text strings. The use of “Enter data fields” is encouraged -- especially inside cells.
- Use lowercase lettering for existing information (initial letter capitalized); use uppercase letters for proposed information.
- MicroStation Font 3 - Engineering is the primary working font.
- Use Font 23 for italics and Font 43 for block letter.
- Place all text using a line style value of zero (lc=0). Any screened or patterned effect on text is handled via pen tables.

Although there are several fonts contained within the udotfont.rsc file, the preferred fonts are described in *Appendix A -Text Fonts*.

Text Size and Spacing

Standard text sizes and fonts have been defined to ensure uniformity and legibility on all CADD drawings. The correct text size is dependent on the plot scale. Since, the most important issue with text is that it should be legible, font and text size may vary as necessary.

For text to be readable, it is necessary to place text a certain distance from any other text located near it. In many cases, text will be placed as a multi-line text string. For this text to be readable a line spacing attribute must also be set. Text line spacing should be, on average, three-fourths of the text height. As a minimum the line spacing will be one-half of the text height. The line spacing can be set in the text settings box or via the key-in: ls=.

Use the following tables to determine the text size and associated line weight to use for a specific text size and plotting scale:

Standard Text Sizes

Imperial Text Sizes for Typical Plotting Scales (for 11 x 17 plots)								
Drawing Scales		**XS** (Extra Small Text)	**S** (Small Text)	**M** (Medium Text)	**L** (Large Text)	**XL** (Extra Large Text)	**Titles**	**Large Titles**
Preferred	Limited Use							
1		0.05	0.06	0.07	0.0875	0.12	0.2	0.3
	10	0.5	0.6	0.7	0.875	1.2	2	3
	20	1	1.2	1.4	1.75	2.4	4	6
30		1.5	1.8	2.1	2.625	3.6	6	9
	40	2	2.4	2.8	3.5	4.8	8	12
	50	2.5	3	3.5	4.375	6	10	15
60		3	3.6	4.2	5.25	7.2	12	18
	80	4	4.8	5.6	7	9.6	16	24
100		5	6	7	8.75	12	20	30
200		10	12	14	17.5	24	40	60

Standard Weights for Text

Text and Associated Line Weights		
Text Size	Normal Text Line Weight	Bold Text Line Weight
Extra Small	1	2
Small	1	2
Medium	1	2
Large	2	3
Extra Large	2	3
Title	3	4
Large Titles	4	5

Placement of Text

The electronic files of a project are divided into two main categories: *design files* and *sheet files.* A design file contains all the information for a particular disipline along the entire length of the project.

Sheet files are created by referencing several design files files and a border into a seed file and then clipping the boundary of the design files to fit the border.

Text used for callouts should be placed in the sheet file and not the design file. Other text such as text for alignment descriptions, contour labels, cross section text, profile text and other similar text can be placed in the corresponding design file.

For more information on the creation of sheet files see *Project Workflow for CADD* (Currently under development).

Sheet files for plan views should generally be place along the alignment to facilitate geometric tracking on the sheet file. Sheet file used for details, cross sections and profiles should not be placed along an alignment. Stationing in a sheet file should generally increase from the bottom to the top of the page or from the left to the right of the page. With this as the standard text should be placed readable from the bottom or right side of the page.

Line Styles

Line style (lc=) is part of the symbology of graphical elements in MicroStation. It defines lines as solid, continuous dashes, dots and dashes, and so on. Each element has its own line style (line code). An element can be set to the standard MicroStation line styles (numbered 0 - 7) or to a custom line style defined in a custom line style resource file. Custom line styles are user definable resource files for the display of different patterns, for example a tree line, fence line, guardrail, etc. When an element is drawn in MicroStation with a custom line style, the definition of the line style *is not* contained within the design file, only the line style name. The resource file from which it was selected must be packaged with the design file and it must be found by MicroStation's configuration in order to properly display the line. Therefore, users are strongly discouraged from creating their own custom line styles; instead using the UDOT supplied standard line style resources.

UDOT uses line styles that represent various linear information types in graphic design files. The line styles are contained in a MicroStation resource file named Uline_MmmYY.rsc where Mmm is the month and YY is the two digit year the resource file was last updated. The Project Setup Utility will copy the most current line style resource file to the *drive:\Project\Resources\Styles* directory. This file is required for use on any UDOT project.

UDOT will modify this resource file periodically. It is, therefore, important to get the newest copy of the linesytle resource file at the beginning of each project. UDOT's line styles are shown in *Appendix B -Custom Linestyles*.

UDOT Custom Line Style Resource Files

As mentioned above, custom line styles are user definable in MicroStation. Caution must be exercised as the definition for the line style is maintained in a resource file; a design file only contains references to custom line style resource files. If a new (non-standard) custom line style is developed by a user, it must be placed in a new resource file and the resource files must be delivered with the project. Users shall not modify the resource file(s) containing the UDOT standard custom line styles.

Line Weight

Line weight is an index in the range 0 to 31 that designates the weight or thickness of the line used to draw or plot a graphic element. Each element has its own line weight. The standard line thickness or width of a plotted graphic element in inches or millimeters for Laser, Electrostatic, or Ink Jet plotters shall be as follows:

Standard UDOT Line Weights

Line Weight	Line Thickness/Width	
	(Inches)	(mm)
0	0.002	0.05
1	0.006	0.15
2	0.014	0.35
3	0.025	0.625
4	0.037	0.95
5	0.059	1.50
6-31	0.002	0.05

Plotting

UDOT uses InterPlot, a product from Bentley Systems, Inc., to produce final plan sets. The resource files for InterPlot are located in the *drive:\Projects\NNNNN_YY\Resources\IPARM* directory. The UDOT.pen file defines the line thickness/width of the plotted graphic element.

Plots can also be produced using a MicroStation V8 plot configuration file (*.plt) to set and control the actual physical thickness of plotted information. A few plot configuration files have been created for standard printers and are located in the *drive:\Projects\NNNNN_YY\SheetFiles\Plotdrv* directory. These plot configuration files can be modified to fit the needs of the project. However, the plot must conform to the standard line weights listed in the table above.

Modifications may need to be made to the displayable screen thicknesses for line weights so they will match the plotter drivers. These display settings are stored in the *.upf file so they must be set on a user by user basis.

Additional plotting information will be added to this manual as procedures and parameters are implemented. Currently, there are four plotter configuration files included in the CAD_Standards resources directory.

Color Table

A standard color table is necessary to provide visual consistency thus allowing users to easily identify elements in shared files and for consistency in color plotting. UDOT uses the standard 16-color table delivered with MicroStation V8 named color.tbl. For convenience, this color table can be found in the *drive:\CAD_Standards\Resources\Styles* directory and is named udotcolor.tbl

Cell Libraries

Standard UDOT cell libraries have been created for use with MicroStation. The cell libraries are found in the following directory:

drive:\CAD_Standards\Resources\Cell_Libraries

MicroStation V8 manages cells differently than previous MicroStation versions. Refer to the current MicroStation V8 help system for information on creating and managing cells. The following table lists the cell libraries that have been developed. Additional cells may be added on a project by project basis. The cells created for project specific use should be stored in a cell library named PPPP.cel where PPPP is the PIN number for the project. This file should be created using the project seed file and stored in the project directory under the *\resources\cell_libraries* sub-directory.

Cell Library Files

Cell Library	Examples
Hydo.cel	storm drainage details and symbols
Landscape.cel	landscape design symbols and details
Profile.cel	profile sheet symbols
Road.cel	road design details and symbols
ROW.cel	right-of-way symbols and details
Sheet.cel	sheet file symbols and details
Signals.cel	signal symbols and details
Signs.cel	roadway signs
Signs_exist.cel	existing roadway signs
Structures.cel	structural details and symbols
Survey.cel	details and symbols for existing features
Traffic.cel	traffic control symbols and details
Udotpat.cel	patterns
Udotsymb.cel	all point cells
Utilities.cel	utility symbols and details

Settings Groups

Settings group files can help users set element attributes to correct symbology (line style, color, weight, text size, and level). To use a settings group,

- Select Settings>Manage from the MicroStation application window
- Open a settings group if the correct one is not already loaded (File>Open in dialog box)
- Select the desired scale (Category>Scale)
- Select a *"Group"* and then a *"Component"*
- MicroStation will automatically activate the correct element attributes and execute the typical tool used to place the component such as the Place SmartLine or Place Cell tool.

Level Library

ETS has developed a standard level library to be used in each design file. The UDOT level library file can help you determine appropriate levels within the active design file for viewing and element placement. The level charts found in *Section 5:CADD Standard Symbology* can help you determine what items are on which levels within the different design files.

Level Filters

The variable MS_LEVEL_LIB_DIR is used to access the level library via reference. This reduces teh need to create teh same level names in different design files. Each level name begins with a prefix

associated with the major design disciplines. This prefix is used for organizational purposes as well as for pre-defined level filters. Using level filters greatly reduces the number of levels that are viewed in the Level Manager or the Level Display dialog boxes.

Seed Files

MicroStation uses "seed" files to create all design files. These seed files are templates in which standard parameters are set according to what is needed to begin drafting for a specific type of work in accordance with UDOT standards. A new feature in MicroStation V8 is the concept of "*models.*" Within the same design file you can have multiple models. Since working units and view attributes are model specific, you can have different working units for each model in the file. Other items defined in the seed file include the default color table, text settings, coordinate readout and several other important new parameters associated with the MicroStation V8 file format. ETS supplies the seed file for English projects in the \CADD_Standards directory and copies it to the projecy using the CADD Utilities program. If a situation occurs where this seed file cannot be used on a specific project, ETS can assist in creating a project specific seed file.

UDOT's seed file contgains only a "default" model that is based on the working units of Feet and Inches. Although its significance has been substantially reduced, UDOT will continue to set the Global Origin. The Global Origin value is model specific and therefore must be independently set for each model within the file.

The UDOT seed file working units are defined below:

Imperial 3D Seed File:

Working Units:

- Master Units = Feet, Label = ft
- Sub-Units = Inches, Label = "
- Resolultion = 10000 per foot

Global Origin:

- X= -10000 Y= -10000 Z= -214748.3648

Using the standard seed file, a project will be developed using project coordinates instead of State Plane or Modified State Plane coordinates. *CADD Requirements for Civil Design* (currently under development) in this manual describes the requirements for project coordinate setup and documentation.

CADD Support Files

UDOT has developed two standard directory structures for CADD files; 1) the *\CAD_Standards* directory for UDOT standard support files, and 2) the *\Projects* directory which contains files specific to the project. The files and directory structure contained in the \CAD_Standards are used across all UDOT projects. Therefore, access rights to the \CAD_Standards directory will be limited to "read only" for production personnel.

The CADD support files are maintained on a CADD system server located in the Calvin Rampton Complex and mirrored on a CADD server in each region. These servers are mapped as the **M:** drive with the files in a directory named \CAD_Standards. Consultants and remote offices can download a self-extracting zip file which contains this information from the ETS website, www.dot.utah.gov/ets/.

Some support files are unique to each project and some are universal to UDOT projects. The project specific files should be copied to the project directory when it is set up. Several of these files will need name changes once they are copied to the project directory. This is don by utilizing the CADD Utilities program developed by ETS. For example, any file whose name includes **NNNNN_YY** will be changed to the actual project identification number (PIN) followed by the STIP year for the project. The following table indicates where certain support files are located:

CADD SUPPORT FILE DIRECTORY STRUCTURE

drive:\CAD_Standards				
	\Doc			Electronic copies of standards manuals and help files.
	\General_Design			Standard application files.
		\Civil UDOTCIVIL.INI UDOT.TML UDOTWYSIWYG.INI		Files for use with InRoads SelectCAD, Storm and Sanitary SelectCAD, and Bridge SelectCAD.These files are renamed when copied by the CADD Utilities program into the project directory.
		\Survey UDOTSURVEY.FWF UDOTSURVEY.FXP		Files for use with Survey SelectCAD.
	\Resources			
		\Application		Programs for installing, maintaining, and removing UDOT projects, resources, and menus.
		\Cell_Libraries		Cell library files (.cel) to attach to design files.
		\Directory Templates		Templates for UDOT directories.
			\Bentley_Udot	Template directory structure for UDOT personnel using a network. Copied as a subfolder to a user specific folder.
			\Nnnnn_yy	Standard directory structure for UDOT projects. Must be copied to the *drive*:\Projects directory and renamed with appropriate PIN and Stip Year.
		\Iparm		Plotting configuration and pen files.
		\Level_names		Level library defining standard UDOT levels.
		\Plotdrv		Plot driver files (.plt) to use for plotting directly from MicroStation.
		\Seed AR_SEED.DGN		Standard seed file. Renamedby the CADD Utilities program to PPPP_seed.dgn in the project directory.
		\Setting_groups		Settings group files (.stg) to attach to design files for help in setting element attributes.
		\Standard_Drawing		Contains standard drawing sheets.
		\Styles		UDOT linestyles, fonts, and color table.
		\Summary Sheets		Standard summary sheets with macros to produce output for the UDOT PDBS system.

Note: *Project Workflow for CADD* in this manual will include information on project set-up and archival procedures. Until it is available, please call the ISS Engineering Support group at 801-965-4901 for help with project set-up and use of the CADD Utilites program.

Section 4: Project Directory and File Names

The Standard Project Directory

Information required to produce a project from conceptual design through record drawings will be included in the directories outlined in this section. A standard format will allow for ease of use, a certain familiarity between departments and projects, and a consistent method of using reference file capabilities.

Each project shall have its own unique project directory. The project directory name shall follow this example: NNNN_YY where NNNN = UDOT Project Identification Number (PIN), and YY = the two-digit STIP year. Example: 456 is the PIN number and the anticipated year of construction (STIP year) is 2005. Thus, the project directory name would be 456_05. The PIN number is available from the UDOT Project Manager. Under the project directory will be standard sub-directories for the different phases of a project, and directories for certain MicroStation support and resource files that are specific to the project. The following table details the standard project directory structure with a description of each directory's purpose. If necessary, additional sub-directories can be added under the discipline specific sub-directories for organizational purposes. The CADD Utilities program will automatically setup the standard project directory structure and populate the sub-directories with the appropriate resource, seed, and configuration files.

PROJECT DIRECTORY STRUCTURE

drive:\Projects\NNNNN_YY				Top Level Project Directory--NNNNN refers to PIN (Project Identification Number) and YY refers to STIP (State Transportation Improvement Program) year; drive will typically be N: on the UDOT network
				Contents
	\Civil_Data			Directory for all civil design files; (.dtm), (.alg), (.tml), (.rwl), (.rwk)
	\Concept			All plans and files from concept and planning phase
	\Design			All design drawing files generated during the design phase, including right-of-way drawings generated during the design process
		\Geotech		
		\Hydraulics		
			\Analysis	
		\Landscape		
		\Right_of_Way		
		\Roadway_Design		
		\Structures		
			\Analysis	
		\Traffic		
		\Utilities		
	\Documentation			
	\Existing			Existing document search, existing utilities drawings, existing right of way drawingsand information, existing signaling information, etc.
	\Image_Files			Contains orthophotos and vizualization files
	\Quantities			Spreadsheets, Engineers estimates, etc.
		\Summary Sheets		
			\PDBS Export_Data	
	\Resources			Standard data files that need to be archived with the project, e.g., preference files, seed file, linestyles, plotter drivers. Files in these subdirectories can be modified to be project specific.
		\Applications		misc mdl programs, CADD Utilities program
		\Borders		
		\Cell Libraries		
		\Iparm		InterPlot configuration files and data files
		\Level_names		
		\Plotdrv		
		\Seed		Standard seed files for UDOT.
		\Setting_groups		
		\Styles		UDOT linestyles, fonts, and color table.
	\Sheet Files			All sheet design files that are produced for any design submittal
		\Geotech		
		\Landscape		
		\Right_of_Way		
		\Roadway_Design		
		\Signals_Lighting		
		\Structures		
	\Specifications			Standard specifications and special provisions related to the project
	\Survey_Data			All data existing data collected from field surveys, aerial or satellite surveys, GPS surveys, etc.
		\Export		
		\Import		
		\Raw_Data		

The Civil_Data Directory

The Civil_Data directory will contain the files produced with the current version of UDOT's civil design software. Currently that software is InRoads. These files include surface files (*.dtm), geometry files (*.alg), template files (*.tml), roadway definition files (*.rwl), and preference files (*.ini). More information on the CADD standards for civil design can be found in *CADD Requirements for Civil Design* (Currently under development). Other information that will be stored in this directory include sheet file images, quality control reports, and the ASCII Engineering Data output files.

File Sharing and Merging

Every project will utilize the standard directory structure regardless of the project requirements, even if the specific project does not include all of the disciplines listed in the standard structure. Data for each discipline will be maintained in its sub-directory, thus insuring the ability to merge data from different providers or disciplines at the time of delivery. **If a discipline requires information from another discipline, the needed file(s) should be referenced from the original directory and not copied.** For example, a Right-of-Way file will reference a Roadway design file, without copying it into the Right-of-Way discipline directory. Each discipline must provide their electronic files in a standard format such that their customer (another discipline in the workflow) can use the data without the need to copy it and manipulate it.

Reference File Attachments

MicroStation V8 is capable of referencing MicroStation V8 models, Pre-MicroStation V8 design files, raster files, or AutoCAD files to the active design model, thus allowing several design groups to share the same information without the need to copy the file(s). MicroStation can attach a reference file by one of three different ways:

1) Name only – the path to the referenced file is resolved by the MicroStation configuration variable MS_RFDIR.
2) Full path – the reference file name and directory path is saved within the master file.
3) URL address – the file is attached in the form of a URL address using relative paths.

In order for a project to be delivered to UDOT in an electronic format that will allow future use of the files for printing purposes without modification to the files, the reference files must be attached in a way that will allow MicroStation to resolve the reference file attachment paths regardless of the drive or parent directory of the project. Option 1 (previous paragraph) is the preferred method for UDOT projects, since it allows the files to be moved from drive to drive without losing the reference file attachments. However, this option requires the MicroStation configuration variable, MS_RFDIR, be

set for all UDOT projects and that all design files reside in the standard UDOTdirectory structure in order to be located. UDOT has set this variable in the project configuration file (*.pcf) file that is created with the CADD Utilities program. If sub-directories are added to the standard project directories, the MS_REFDIR variable in the project *.pcf file will need to be modified to include the new directories.

If for some reason, two files with the same name reside in two different directories of the project, MicroStation will attach the first matching filename it finds in the variable path. By following the file naming requirements set forth in this section, duplicate file names will be avoided within the standard project directory structure.

Reference File Logical Names

A single MicroStation model or AutoCAD file can be attached to the current active model several times. MicroStation V8 distinguishes the different attachment instances by using a "*logical name.*" UDOT also uses the logical name of a reference file to control plotting parameters such as gray scaling specific information of a sheet file that is in a reference file. Use the Logical Name Prefix listed in the appropriate *Level Charts* table beginning *on page 2-71* as a prefix to the Logical Name defined in the "*Attach Reference Settings*" dialog box.

Standard File Names

The UDOT standard project directory structure and file naming conventions are based on the normal workflow of UDOT projects and the separation of workgroups. This allows the individual workgroups and disciplines to manage their own files, and eventually maintain their individual project indexes, and ASCII output, without repercussions when the entire project is packaged together for delivery.

This section outlines the standard file names to be used for design files and sheet files. The distinction between the two files can be summarized as follows: 1) design files show the entire project in one file for each discipline while sheet files break the project into manageable lengths and show multiple disciplines, 2) design files contain actual design information while sheet files contain mostly references to the design files, and 3) design files do not contain a border while sheet files do contain a border. Therefore, there are different standard naming conventions for files used as design files verses files used as sheet files.

Design information will be stored in separate files for different disciplines. A given set of design information will still be stored in one file only; reference files will be used to keep information up to

date with design data from other groups. Breaking the design information into smaller pieces has several benefits:

1) Various departments and designers can work simultaneously instead of serially,
2) Any updates only have to be made once for all sheets to be updated, and
3) Users will not be slowed down by having to wait for large amounts of graphics to regenerate during panning and zooming operations.

Design files for a project will be located in the \Design and \Existing subdirectories of the project. Sheet file will be located in the \Sheet_Files subdirectory. Each category will be broken into different types of information in several design files.

Design File Naming Convention

Each of the file names will follow a consistent naming convention following this example:

PPPP_StdName_ANumeric_n.dgn.

where PPPP is the PIN number for the project, StdName is one of the standard names from the "Standard Name" column of the table *"Existing Directory Filenames"* or the table *"Design Directory Filenames"* beginning *on page 2-66*, ANumeric is an alpha-numeric description up to 8 character long, and "n" is the revision number of the drawing.

PPPP and StdName are required to be used. However, ANumeric and "n" are not required and are used at the discretion of the designer for ease of identifying files.

The ANumeric field could be used to identify different base files when a design is so large that more than one base file is necessary. As an example, I-15 has four design sections. Thus, the naming convention for this project would be similar to PPPP_design_Sect1.dgn, PPPP_design_Sect2.dgn, etc. The ANumeric field could also be used to identify miscellaneous data that is not coordinate specific such as details and typicals. As an example, PPPP_design_typicals and PPPP_design_details.

The revision number, "n", is only used to keep track of different stages of the design or major changes to a design. A higher revision number means that the stage or change is more recent than one with a lower number. The base file used as the actual design of the project and as a reference in the sheet files must not have a revision number

The following table lists the standard file names for files located in the \Existing directory.

Existing Directory Filenames

Standard Name	Reference File Logical Name Prefix	Description
Exrow	Erow	Existing right-of-way information -- may include information concerning property descriptions, right-of-way easement locations, etc.
Exsignal	Esig	Existing traffic signalizations, electric loops, activators, etc.
Extopo	Extp	Existing topography -- may contain existing topographic contours at different intervals, spot shots, locations of various topographic features, storm sewers etc.
Exutil	Exut	Existing utility information -- may contain information concerning existing utility easements, locations of existing utilities such as sanitary sewers, telephone lines, natural gas lines, oil pipe lines, ATMS etc.

The following table lists the standard file names for files located in the \Design directory

Design Directory Filenames

Standard Name	Reference File Logical Name Prefix	Description
		This directory contains all base engineering files developed as a result of the design effort.
Atms		
Design	Des	Proposed roadway design information
Geotech	Geo	Geotechnical design including boring locations
Profile	Prof	Contains final profiles
Xsection	Xsec	Contains final cross sections
Utilities	Util	Proposed utility plans -- corresponding profiles and cross sections will be placed in the profile and cross section files
Hydro	Hydr	Proposed hydraulic designs including storm sewers, detention and retention pond designs, basin maps, etc.
Structures	Str	Proposed structural designs including bridges, culverts not covered by standard details, etc.
Row	Row	Information necessary for final property purchase including legal descriptions, plot maps, etc.
TrafControl	Traf	Information necessary for temporary traffic control including lane striping, construction and detours.
Landscape	Land	Landscaping design information including planting requirements, sprinkler systems, etc.
Signal	Sig	Signaling information such as conduit locations and sizes
Signing	Sign	Signing and striping information

Note: A file named PIN_work.dgn can be used as a scratch or working file rather than a presentation file to be plotted. Its purpose is to provide a location for the designer to try alternative designs and

develop ideas. Work.dgn files will be deleted when the project is archived. Thus, the PIN_work.dgn file should never be used as a reference file within the final sheet files.

Standard Sheet File Naming Convention

Each of the file names will follow a consistent naming convention following this example:

PPPP_ID-#_ANumeric_n.dgn.

where PPPP is the PIN number, ID-# is a standard plan sheet code from standard drawing sheet 1A followed by the page number, ANumeric is an alpha-numeric description up to 8 character long, and "n" is the revision number of the drawing.

See Standard Sheet 1A, "Plan Sheet Codes and Descriptions" for a list of sheet ID codes that can be used.

PPPP and ID-# are required to be used. However, ANumeric and "n" are not required and are used at the discretion of the designer for ease of identifying files. As an example; a file named 936_TC-1.dgn would be the file name for sheet 1 of the traffic control sheets for a project with a PIN number of 936.

Structures Sheet Files Naming Convention

Each of the structures sheet file names will follow the naming convention following this example:

PPPP_DRG#-Sht#_ANumeric_n.dgn.

where PPPP is the PIN number, DRG# is the bridge number, Sht# is the sheet number for the bridge plan sheet, ANumeric is an alpha-numeric description up to 8 character long, and "n" is the revision number of the drawing.

The bridge number generally follow the format A-### where A is an alpha character and ### is a number. For consistency, the dash between the alpha character and the number should be included in the DRG#. The Sht# sequence begins at 1 for each bridge included in the project.

PPPP and DRG# are required to be used. However, ANumeric and "n" are not required and are used at the discretion of the designer for ease of identifying files. As an example; a file named 936_C-815-23_steel-schd.dgn would be the file name for sheet 23 of the plan sheet that contains the reinforcing steel schedule for bridge number C-815 for a project with a PIN number of 936.

Section 5: CADD Standard Symbology

Guidelines for Symbology

Element symbology is the level, color, line style, line weight, text, font, and feature code of an element as assigned in MicroStation. The *Level Charts* at the end of this chapter are used to determine what items are on which level within different design files. In addition to defining level usage for typical features, the charts define the logical name prefix to use when referencing the design file into other files, the level name prefix to be used for level grouping purposes, the predefined level filter name, and the settings group file to be used. Selecting a component from the settings group file will set the level, color, line style, line weight, and/or font symbology for each of the features listed in the level chart.

The "Number" column in the *Level Charts* is used for orginizational purpose and should not be confussed with the "Level number" concept in previous versions of MicroStation. Within the charts there are also noticeable groupings of levels. These groupings are further defined as sub-filters to the main file filter.

The purpose of assigning a specific symbology requirement to each element is to ensure the interpretation of an element, either by a person or by a computer program, is the same regardless of who or how many access the information later. Graphical CADD data is shared or accessed by many individuals and software, and standards ensure the ability to automate the process of generating quantities, cross sections, drainage structure sheets etc.

There are occasions to deviate from standards, and examples include fonts and text sizes. These are somewhat flexible and should be set according to the need of the designer. See the Table "Standard Text Sizes" on page 2-52 to set an appropriate text size according to the plot scale of the drawing. However, if there is occasion to knowingly deviate from standards, then the justification for such a decision must be documented in the CADD Journal. Both the designer and reviewer of a design file must keep in mind the intent of the Level charts and Settings Groups; make the file useable by all parties and automate computer processes, without overly complicating the drawing process. If an element is critical to the design process and workflow, it must be drawn according to the UDOT CADD symbology standards. If the element in question is only part of a graphical picture not accessed by

other parties than the originator, then flexibility exists as long as the information is documented in the project CADD Journal. There are three criterion that determine if an element is considered critical:

1) Does the element reside in a design file that is shared by other groups? Example: the topography file, Pin_extopo.dgn, is shared by multiple groups and must be created in a format that allows it to be shared (referenced in MicroStation) by all affected groups without requiring them to copy the original and modify it to fit their needs.
2) Is the element used to generate Plan quantities? Example: the Roadway proposed design file, Pin_design.dgn, is used to generate several quantities and to provide the boundaries of other quantities. Therefore all elements created in this type of file must be in accordance with the UDOT CADD symbology standards.
3) Is the element used by subsequent customers for supplying data automatically to additional software packages? Example: The Roadway cross-section files, Pin_xsection_ANumeric.dgn, are used by Construction to check earthwork quantities. The success of this process depends on strict adherence to the UDOT CADD symbology standards.

Precedence Hierarchy for interpreting the CADD Symbology Standards

The UDOT CADD symbology standards are stored in several formats. These include *Part 2:CADD Standards* and *CADD Requirements for Civil Design* (Currently under development) of this document, the InRoads civil.ini and wysiwyg.ini preference files, the Settings Group files. Inherrent to the inability to automatically update each of these sources references to CADD Symbology, a degree of error might be introduced between the different tables, resources, or preferences. If the user of these resources encounters a conflict in standards, ETS should immediately be notified so the situation can be rectified. When in doubt as to which standard to apply, an order of precedence for choosing between competing standards is required. The precedence table is shown below, going from highest precedence (top) to lowest (bottom):

Order of Precedence of the UDOT CADD Symbology Standards:

- *Part 2:CADD Standards*
- InRoads civil.ini and wysiwyg.ini preference files
- *CADD Requirements for Civil Design* (Currently under development)
- Settings Group Files

Level Charts

The Level names in the following table may be used in all design and sheet files. Level names in subsequent tables should be used in their associated dgn file.

Non-Plotting

Associated dgn: May be used in all files		
Level Name	**Typical Features**	**Number**
NOPLOT: NonPrint	Elements placed on this level will not be printed. To be used in all files.	2000
NOPLOT: Plot Boundaries	Plot shape to define printing area.	2001
NOPLOT: Clipping Boundaries	Shapes used to define reference file clipping boundaries.	2002
NOPLOT: Mask Boundaries	Shapes used to define reference file mask boundaries.	2003
NOPLOT: Design Notes	Design notes and file information text.	2004

Level Filter/Settings Group Name: N/A

Level Name/Logical Name Prefix: N/A

Level Number Range: 2000-2004

Existing Right of Way

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Exrow_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Boundaries		
EROW: Political Boundary Lines	Government Land Office (GLO) lines, state, county reservation, and park boundaries	100
EROW: Political Boundary Points	section corners, township corners, etc.	101
EROW: Property Lines	property, subdivision, lot, block lines, etc.	102
EROW: Property Points	property corners	104
EROW: UDOT Boundary	maintenance and district boundaries	105
ROW		
EROW: Easement Lines	utility easements, construction, work lines, etc.	110
EROW: Access Lines	L/A, N/A lines	111
EROW: ROW Lines	highway, frontage, railroad ROW lines	112
EROW: ROW Points	monuments, ROW markers	113
Text		
EROW: Political Boundary Text	political boundary text	120
EROW: Political Points Text	political points text	121
EROW: Property Text	property point & line text	122
EROW: UDOT Boundary Text	UDOT boundary text	123
EROW: Easement Text		124
EROW: Access Line Text	L/A, N/A text	125

Level Filter/Settings Group Name: Exrow

Level Name/Logical Name Prefix: EROW:

Level Number Range: 100-199

Existing Signal

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Exsignal_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Hardware		
ESIG: Controller Cabinet		200
ESIG: Signal Pole		201
ESIG: Signal Mast Arm		202
ESIG: Underground Service Pedestal		203
ESIG: Luminaire Extension and Arm		204
ESIG: Pedestrian Pole		205
ESIG: Light Pole		206
ESIG: Span Wire Signal Pole		207
Boxes		
ESIG: Detector Loop Junction Box	Detector Loop Junction Box.	210
ESIG: Pedestrian Junction Box	Ped, Push Button, Future Use Junction Box	211
ESIG: Signal Junction Box	Signal Junction Box	213
ESIG: Lighting Junction Box	Lighting Junction Box	214
Conduit		
ESIG: Detector Conduit		220
ESIG: Pedestrian and Push Button Conduit		221
ESIG: Signal Conduit		222
ESIG: Lighting Conduit		223
ESIG: Future Conduit		224
ESIG: Power Source Conduit	Conduit for signal and lighting power	225
ESIG: Temporary and Other Use Conduit		226
Devices		
ESIG: Detector Loop		230
ESIG: Pedestrian Signal Head		231
ESIG: Traffic Signal Head		232
ESIG: Standard Luminaire		234
ESIG: Opticom		235
ESIG: Video Camera		236
ESIG: Power Source	Power source for signal and lighting	237
Text		
ESIG: Signal Text		240
ESIG: Circuit Text		241
ESIG: Miscellaneous Text		242
ESIG: Pole ID		243
ESIG: Border Text		244
ESIG: Match Lines		245
Signs		
ESIG: Mast Arm Mounted Sign		250
ESIG: Street Name Sign		251
ESIG: Variable Message Sign		252

Level Filter/Settings Group Name: Exsignal

Level Name/Logical Name Prefix: ESIG:

Level Number Range: 200-299

Existing Topography

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Extopo_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Survey		
EXTP: Survey Points	benchmarks, control pts	300
EXTP: Control Lines		301
Roadway		
EXTP: Curb and Gutter		305
EXTP: Edge of Paved Road	paved, edge of oil	306
EXTP: Edge of Unpaved Road	unpaved, gravel	307
EXTP: Barriers	guard rail, attenuators, etc.	308
EXTP: Driveways	driveways, parking lots	309
EXTP: Sidewalks	sidewalks, misc. flatwork	310
EXTP: Highway Signs	signs, reference posts	311
EXTP: Commercial Signs		312
EXTP: Mailboxes		313
EXTP: Paint	striping, pavement markers	314
EXTP: Roadway Slope Features	toe/top of fill/cut slope	315
EXTP: Misc Roadway Features		316
Surfaces		
EXTP: Index Contours	index contours	320
EXTP: Intermediate Contours	intermediate contours	321
EXTP: Breaklines	DTM breaklines	322
EXTP: Spot Elevations	Natural ground shots, top of concrete, top of asphalt, etc.	323
EXTP: Fences		324
EXTP: Paths and Trails		325
EXTP: Ditches	top of ditch, ditch flow lines, etc.	326
EXTP: Surface Features	swales, berms, pits, stockpiles	327
EXTP: Vegetation	trees, shrubs, ground cover, etc	328
EXTP: Water Features	rivers, canals, lakes	329
EXTP: Wetlands	delineated wetlands	330
EXTP: Misc Surface Features		331
Hydraulics		
EXTP: Hydraulic Structures	headwalls, diversion boxes, drop inlets, etc	335
EXTP: Culverts	pipe culverts, end sections	336
EXTP: Riprap		337
Structures		
EXTP: Road Structures	bridges, abutments, piers	340
EXTP: Walls	retaining walls, etc.	341
EXTP: Noise Walls	sound barriers	342
EXTP: Buildings	building outlines, etc.	343
EXTP: Misc Structures	pads, tanks, bollards, etc.	344
EXTP: Railroads		345

Existing Topography

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Extopo_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Text		
EXTP: Survey Text	Point names, notes, etc.	350
EXTP: Surface Text	contour text	351
EXTP: Spot Elevation Text	spot elevation text	352
EXTP: Gridmarks and Text	survey grids, aerial grid marks	353
EXTP: Sign Text		354
EXTP: Misc Text		355

Level Filter/Settings Group Name: Extopo

Level Name/Logical Name Prefix: EXTP:

Level Number Range: 300-399

Existing Utility

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Exutil_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
EXUT: ATMS	ATMS lines and structures	400
EXUT: Cable TV	cable lines and structures	401
EXUT: Electrical	electrical lines and structures	402
EXUT: Gas	gas lines and structures	403
EXUT: Telephone	telephone lines and structures	404
EXUT: Sanitary Sewer	san. sewer lines & structures	405
EXUT: Water	water lines and structures	406
EXUT: Irrigation	irrigation lines and structures	407
EXUT: Petroleum	petroleum lines and structures	408
EXUT: Fiber Optic	all fiber optic lines	409
EXUT: Utility Text		420

Level Filter/Settings Group Name: Exutil

Level Name/Logical Name Prefix: EXUT:

Level Number Range: 400-499

ATMS

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Atms_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Boxes		
ATMS: Type I-PC Junction Box	Type I Polymer Concrete Junction Box	1700
ATMS: Type II-PC Junction Box	Type II Polymer Concrete Junction Box	1701
ATMS: Type III-PC Junction Box	Type III Polymer Concrete Junction Box	1702
ATMS: Type I-P Junction Box	Type I Plastic Junction Box	1703
ATMS: Type II-P Junction Box	Type II Plastic Junction Box	1704
Conduit		
ATMS: Duct Bank Conduit	Fiber Cables	1710
ATMS: High Voltage Conduit	Signal Conductors, VMS Power Conductors, Camera Power Cables, or Camera Composite Cables	1711
ATMS: Low Voltage Conduit	Detector Loop Lead-In Cable, VMS Control Cables, Camera Cables, RWIS Cables	1712
ATMS: Tail Circuit Conduit	Tail Circuit Communications, Copper Comm Cables	1713
ATMS: Spare Conduit	Spare Conduits	1714
ATMS: Power Conduit	Conductors w/ voltage greater than 120V between power service point and power service pedestal	1715
ATMS: Interconnect Conduit		1716
Devices		
ATMS: CCTV	Closed Circuit Television	1720
ATMS: HAR	Highway Advisory Radio Station	1721
ATMS: TMS	Traffic Monitoring Station	1722
ATMS: RWIS	Roadway Weather Information System Station	1723
ATMS: Controller	ATMS Controller Cabinet	1724
Text		
ATMS: Text		1730

Level Filter/Settings Group Name: ATMS

Level Name/Logical Name Prefix: ATMS:

Level Number Range: 1700-1799

Design

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Design_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Alignments		
DES: Curb and Gutter		510
DES: Edge of Paved Road	paved, edge of oil	511
DES: Edge of Unpaved Road	unpaved, gravel	512
DES: Barriers	guard rail, attenuators, etc.	513
DES: Horiz Alignments		514
DES: Horiz Alignment Point	PCs, PTs, Event Points, etc.	515
DES: Horiz Alignment Stationing	Alignment Stationing	516
DES: Curve Data and Bearings		517
DES: Horiz Alignment Major Ticks	Alignment Stationing Major Ticks	518
DES: Horiz Alignment Minor Ticks	Alignment Stationing Minor Ticks	519
Roadway (level filter includes Alignments grouping)		
DES: Driveways	driveways, parking lots	520
DES: Sidewalks	sidewalks, misc. flatwork	521
DES: Roadway Slope Features	toe/top of fill/cut slope	522
DES: Mailboxes		523
DES: Misc Roadway Features		524
Surface Features		
DES: Breaklines	DTM breaklines	530
DES: Fences		531
DES: Paths and Trails		532
DES: Water Features	rivers, canals, lakes, wetlands	533
DES: Misc Surface Features		534
DES: Index Contours	index contours	535
DES: Intermediate Contours	intermediate contours	536
DES: Spot Elevations	spot elevations	537
Structures		
DES: Road Structures	bridges, abutments, piers	540
DES: Walls	retaining walls, etc.	541
DES: Noise Walls	sound barriers	542
DES: Buildings	building outlines, etc.	543
DES: Misc Structures	pads, tanks, bollards, etc.	544
DES: Railroads		545
Text		
DES: Alignment Text	curve data, stationing, bearings	551
DES: Surface Text	contour text, spot elevation text, etc	552
DES: Spot Elevation Text		553
DES: Design Text		554

Design

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Design_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**

Level Filter/Settings Group Name: Design

Level Name/Logical Name Prefix: DES:

Level Number Range: 500-599

Geotech

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Geotech_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
GEO: Borings	Location of boring holes	1900
GEO: General	Geotechnical general use level.	1902
GEO: Text		1904

Level Filter/Settings Group Name: Geotech

Level Name/Logical Name Prefix: GEO:

Level Number Range: 1900-1999

Hydraulics

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Hydro_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Surfaces		
HYDR: Ditches	flow lines, top of ditch, etc..	600
HYDR: Water Surface		601
Structures		
HYDR: Pipes	pipes, end sections, trash racks	610
HYDR: Water Features	ponds, lakes, canals, etc.	611
HYDR: Hydraulic Minor Struct	storm mh, drop inlets, cleanout box	612
HYDR: Energy Dissipator		613
HYDR: Hydaulic Major Struct	headwalls, wingwall	614
HYDR: Hydraulic Grade Line		615
HYDR: Riprap		616
Text		
HYDR: Surface Text		620
HYDR: Structures Text		621
HYDR: Utility Text		622

Level Filter/Settings Group Name: Hydro

Level Name/Logical Name Prefix: HYDR:

Level Number Range: 600-699

Landscape

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Landscape_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Vegetation		
LAND: Plantings	trees, shrubs, ground covers, mulch, topsoil, planters	700
LAND: Seeding	drill, broadcast	701
LAND: Sod		702
LAND: Mowstrip	concrete, timber, vinyl	703
SiteDevelopment		
LAND: Landscape Grading		710
LAND: Irrigation System	rotary, pop-up, impact, bubbler, controllers, pumps, meters, pipe, valves	711
SiteFeatures		
LAND: Specialty Paving	brick, exposed aggregate	720
LAND: Boulders	decorative riprap and rocks	721
LAND: Site Amenities	picnic table, pavilion, signs, etc.	722
Hydraulics		
LAND: Temporary Erosion Control	straw bale, silt fence	730
LAND: Erosion Control Blankets		731
LAND: Channel Liner		732
LAND: Wetland Mitigation		733
Text		
LAND: Irrigation Text		740
LAND: Landscape Text		741

Level Filter/Settings Group Name: Landscape

Level Name/Logical Name Prefix: LAND:

Level Number Range: 700-799

Profile

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Profile_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Roadway(level filter includes Surfaces grouping)		
PROF: Curb and Gutter	curb & gutter lines & symbols	800
PROF: Edge of Road	eoa, edge of oil, etc.	801
PROF: Vertical Alignments	profile grade lines	802
PROF: Vertical Alignment Points	PVCs, PVTs, event pts	803
Surfaces		
PROF: Natural Ground Lines	natural ground lines	810
PROF: Proposed Ground Lines	proposed ground lines	811
PROF: Ditches		812
PROF: Water Surface		813
Structures		
PROF: Exist Structures		820
PROF: Proposed Structures		821
PROF: Railroads		822
Utilities		
PROF: Cable TV		830
PROF: Electrical		831
PROF: Gas		832
PROF: Telephone		833
PROF: Sanitary Sewer		834
PROF: Water		835
PROF: Irrigation		836
PROF: Petroleum		837
PROF: Fiber Optic	all fiber optic lines	838
Text		
PROF: Alignment Text		840
PROF: Surface Text		841
PROF: Grid Lines		842
PROF: Axis and Text	axis lines and axis annotation	843
PROF: Misc Text	misc. profile & xsection text	844
PROF: Dimensions	dimension lines & text	845

Level Filter/Settings Group Name: Profile

Level Name/Logical Name Prefix: PROF:

Level Number Range: 800-899

Right of Way

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_ROW_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Boundaries		
ROW: Political Boundary Lines	Government Land Office (GLO) lines, state, county reservation, and park boundaries	900
ROW: Political Boundary Points	section corners, township corners, etc.	901
ROW: Property Lines	property, subdivision, lot, block lines, etc.	902
ROW: Property Points	property corners	903
ROW: UDOT Boundary	maintenance and district boundaries	905
ROW		
ROW: Easement Lines	utility easements, construction, work lines, etc.	910
ROW: Access Lines	L/A, N/A lines	911
ROW: ROW Lines	highway, frontage, railroad ROW lines	912
ROW: ROW Points	monuments, ROW markers	913
Text		
ROW: Political Boundary Text	political boundary text	920
ROW: Political Points Text	political points text	921
ROW: Property Text	property point & line text	922
ROW: UDOT Boundary Text	UDOT boundary text	923
ROW: Easement Text		924
ROW: Access Line Text	L/A, N/A text	925
ROW: ROW Text		926

Level Filter/Settings Group Name: ROW

Level Name/Logical Name Prefix: ROW:

Level Number Range: 900-999

Signal

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Signal_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Hardware		
ESIG: Controller Cabinet		1000
ESIG: Signal Pole		1001
ESIG: Signal Mast Arm		1002
ESIG: Underground Service Pedestal		1003
ESIG: Luminaire Extension and Arm		1004
ESIG: Pedestrian Pole		1005
SIGL: Temporary Signal Pole		1006
ESIG: Light Pole		1007
Boxes		
ESIG: Detector Loop Junction Box	Detector Loop Junction Box.	1010
ESIG: Pedestrian Junction Box	Ped, Push Button, Future Use Junction Box	1011
ESIG: Signal Junction Box	Signal Junction Box	1012
ESIG: Lighting Junction Box	Lighting Junction Box	1013
SIGL: Temporary Junction Box	Temporary/ Other Use Junction Box	1014
Conduit		
ESIG: Detector Conduit		1020
ESIG: Pedestrian and Push Button Conduit		1021
ESIG: Signal Conduit		1022
ESIG: Lighting Conduit		1023
ESIG: Future Conduit		1024
ESIG: Power Source Conduit	Conduit for signal and lighting power	1025
ESIG: Temporary and Other Use Conduit		1026
Devices		
ESIG: Detector Loop		1030
ESIG: Pedestrian Signal Head		1031
ESIG: Traffic Signal Head		1032
ESIG: Standard Luminaire		1033
ESIG: Opticom		1034
ESIG: Video Camera		1035
ESIG: Power Source	Power source for signal and lighting	1036
SIGL: Temporary Signal Head		1037
Text		
ESIG: Signal Text		1040
ESIG: Circuit Text		1041
ESIG: Miscellaneous Text		1042
ESIG: Pole ID		1043
ESIG: Border Text		1044
ESIG: Match Lines		1045

Signal

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Signal_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Signs		
ESIG: Mast Arm Mounted Sign		1050
ESIG: Street Name Sign		1051
ESIG: Variable Message Sign		1052

Level Filter/Settings Group Name: Signal

Level Name/Logical Name Prefix: SIGL:

Level Number Range: 1000-1099

Signing

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Signing_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Signs		
SIGN: Signs	street, overhead, advertising signs, etc.	1100
SIGN: Delineators		1110
Pavement Markings		
SIGN: Messages	stop bar, RR cross, arrows, etc..	1120
SIGN: Striping		1130
Text		
SIGN: Sign Text		1140
SIGN: Delineator Text		1141
SIGN: Message Text	pavement message text	1142
SIGN: Striping Text		1143

Level Filter/Settings Group Name: Signing

Level Name/Logical Name Prefix: SIGN:

Level Number Range: 1100-1199

Structures

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Structures_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Text		
STR: Text Basic	Titles, notes	1200
STR: Callouts	Descriptive text with witness lines	1201
STR: Alignment Text	Alignment Information, Stationing PC's, PT's and directions listed	1202
STR: Comment Text	Level is not to be printed and contains directions on how sheet should be modified (In-house standard sheets)	1203
STR: Detail Text	Any text associated with a detail that needs to be at a smaller size. Used in preliminary design only.	1204
Superstructure		
STR: Superstructure Basic	Basic level, can be used for all superstructure elements.	1210
STR: Deck	Deck outline	1211
STR: Framing	Framing plan, incl. girders, stiffeners, diaphrams, etc.	1212
STR: Beam and Girder	concrete beams, steel girders	1213
STR: Parapet	Parapet outline	1214
STR: Approach	Approach slab outline	1215
STR: Fence and Rail	Fence/rail location	1216
STR: Utilities	Shows location of all utilities crossing structure	1217
STR: Sidewalk and Curb	Shows location of sidewalks or curbs required on structures	1218
STR: Signs	Shows locations of signs required on structure	1219
Substructure		
STR: Substructure Basic	Basic level, can be used for all substructure elements	1220
STR: Piles	Pile locations	1221
STR: Footings	Footing outlines	1222
STR: Abutments	Abutment outlines	1223
STR: Piers	Pier outlines, incl. columns and bents	1224
Geometry		
STR: Control Line	Lines defining the alignment(s)	1230
STR: Centerline	Generic level for centerlines	1231
STR: Centerline Bearings	Centerline of bearings	1232
STR: Centerline Bents	Centerline of bents	1233
STR: Centerline Girders	Centerline of girders	1234
STR: Joint	Joint lines	1235
STR: Construction Lines	Constructions lines - nonprint level - used by IPLOT to define the plotting area	1236
STR: Contours	Contour lines defining new grading	1237
STR: Cogo Points	Level shows cogo points - level is for preliminary design and will not be printed in final submittal	1238
STR: Cogo Text	Level shows cogo points #'s and descriptions - level is for preliminary design and will not be printed in final submittal	1239
Details		
STR: Detail Basic	Basic level, can be used for all detail elements	1240

Structures

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Structures_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
STR: Concrete Details	Concrete lines	1241
STR: Steel Details	Steel Lines	1242
Misc		
STR: Misc Basic	Basic level, can be used for all "misc."elements.	1245
STR: Slopepaving	Plan view of slope paving	1246
STR: Fences	Fences not on superstructure	1247
STR: Drains	Deck drains, underdrains, approach slab drains etc	1248
STR: Riprap	Plan View of Riprap	1249
Rebar		
STR: Rebar Basic	Basic level, can be used for all rebar elements, or rebar not defined below.	1250
STR: Deck Slab Rebar	Bars originating in the deck, "S" Bars	1251
STR: Parapet Rebar	Bars originating in the parapet, "P" Bars	1252
STR: Approach Rebar	Bars originating in the approach slab, "Z" Bars	1253
STR: Abutment Rebar	Bars originating in the abutment, "A" Bars, or finwalls, "F" bars	1254
STR: Diaphragm Rebar	Bars originating in diaphragms, "D" Bars	1255
STR: Wing Wall Rebar	Bars originating in the Wingwalls, "W" Bars	1256
STR: Footing Rebar	Bars originating in the Footing, "F" Bars	1257
STR: Column Rebar	Bars originating in the deck, "C" Bars	1258
STR: Bent Cap Rebar	Bars originating in the bent cap, "B" Bars	1259
Existing Structures		
STR: Existing Basic	Basic level, can be used for all existing elements, or existing elements not defined below.	1260
STR: Existing Deck	Existing Deck outline	1261
STR: Existing Girder	Centerlines of existing girders	1262
STR: Existing Substructure	Outline of existing substructures	1263
STR: Existing Approach	Outline of existing approach slab	1264
STR: Existing Roadway	Outline of existing roadway	1265
STR: Existing Wall	Outline of existing retaining walls	1266
STR: Existing Utility	Centerlines of existing utilities	1267
Walls		
STR: Wall Basic	Basic level, can be used for all wall elements, or wall elements not defined below.	1270
STR: Concrete Walls	Cast in place concrete walls incl. wing walls	1271
STR: MSE Walls	MSE walls	1272
STR: Wall Text	Text for wall drawings	1273
Signs		
STR: Layout	Location of signs in plan view	1275
STR: Drawing	Sign details	1276
STR: Sign Text	Sign Text	1277
Dimensions		

Structures

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Structures_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
STR: Dimension Basic	Basic level, can be used for all dimensions, or dimensions not defined below.	1280
STR: Sheet 1 Dimensions	Dimensions used on sheet 1	1281
STR: Framing Dimensions	Dimensions used on framing plan	1282
STR: Abutment and Bent Dimensions	Dimensions used on abutment footing plan or bent footing plan	1283
STR: Footing Dimensions	Dimensions used on abutment plan or bent plan	1284
Design		
STR: Sketch	Basic level, can be used for any design function, sketches dimensioning etc	1290
STR: Phase 1 Data	Phase 1 data	1291
STR: Phase 2 Data	Phase 2 data	1292
STR: Dimensions Phase 1	Dimension info, usually associated with phase 1	1293
STR: Dimensions Phase 2	Dimension info, usually associated with phase 2	1294
STR: Dimensions Phase 3	Dimension info, usually associated with details	1295
STR: Dimensions Phase 4	Dimension info, usually associated with details	1296
STR: Elevations	Elevations from inroads, screed sheet or others	1297

Level Filter/Settings Group Name: Structures

Level Name/Logical Name Prefix: STR:

Level Number Range: 1200-1299

Traffic Control

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_TrafControl_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Signs		
TRAF: Temp Signs	temporary signs	1300
Pavement Markings		
TRAF: Temp Pavement Marking	temporary traffic striping	1310
TC Devices		
TRAF: Temp Barriers	tmp barrier, attenuator, end sec	1320
TRAF: Warning Devices	adv. warning panels, etc.	1330
TRAF: Channel Devices	cones, barrels, barricades, etc.	1331
TRAF: Equipment	flagger sta., pilot cars, etc.	1332
Project Information		
TRAF: Work Area	area limits, cross hatching, etc.	1340
TRAF: Direction Indicators	direction of traffic, direction of work vehicle, etc.	1341
Text		
TRAF: Traffic Control Text		1350

Level Filter/Settings Group Name: Trafcontrol

Level Name/Logical Name Prefix: TRAF:

Level Number Range: 1300-1399

Utility

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Utilities_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
UTIL: Cable TV	ATMS lines and structures	1400
UTIL: Electrical	cable lines and structures	1401
UTIL: Gas	electrical lines and structures	1402
UTIL: Telephone	gas lines and structures	1403
UTIL: Sanitary Sewer	telephone lines and structures	1404
UTIL: Water	san. sewer lines & structures	1405
UTIL: Irrigation	water lines and structures	1406
UTIL: Petroleum	irrigation lines and structures	1407
UTIL: Fiber Optic	petroleum lines and structures	1408
UTIL: Utility Text	all fiber optic lines	1410

Level Filter/Settings Group Name: Utilities

Level Name/Logical Name Prefix: UTIL:

Level Number Range: 1400-1499

Cross Sections

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_Xsection_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Roadway		
XSEC: Curb and Gutter	curb & gutter lines & symbols	1500
XSEC: Edge of Road	edge of oil, asphalt, etc.	1501
XSEC: Barriers	guard rail, med. barrier, etc.	1502
Surfaces		
XSEC: Natural Ground Lines	natural ground lines	1510
XSEC: Proposed Ground Lines	proposed ground lines	1511
XSEC: Subgrade Lines	proposed subgrades	1512
XSEC: Fences		1513
XSEC: Ditches		1514
XSEC: Water Surface		1515
Structures		
XSEC: Exist Structures	manholes, ss lines, headwalls, etc	1520
XSEC: Proposed Structures		1521
XSEC: Walls		1522
XSEC: Noise Walls		1523
XSEC: Misc Structures		1524
XSEC: Railroads		1525
Utilities		
XSEC: Cable TV		1530
XSEC: Electrical		1531
XSEC: Gas		1532
XSEC: Telephone		1533
XSEC: Sanitary Sewer		1534
XSEC: Water		1535
XSEC: Irrigation		1536
XSEC: Petroleum		1537
XSEC: Fiber Optic		1538
Text		
XSEC: Area and Volume Text	text for area and volume calculations	1540
XSEC: Grid Lines		1541
XSEC: Axis and Text	axis lines and axis annotation	1542
XSEC: Misc Text	misc. profile & xsection text	1543
XSEC: Surface Text		1544
XSEC: Dimensions	dimension lines & text	1545

Level Filter/Settings Group Name: Xsection

Level Name/Logical Name Prefix: XSEC:

Level Number Range: 1500-1599

Sheet Files

Associated dgn: Drive:\Projects\nnnn_yy\Existing\PPPP_ID-#_ANumeric_n.dgn		
Level Name	**Typical Features**	**Number**
Graphics		
SHT: Misc Annotation	north arrow, border lines, flags	1600
SHT: Detail Graphics		1601
SHT: Patterning	patterns, hatching	1604
SHT: Title Block Graphics		1605
SHT: Dimensions	dimension lines & text	1610
Text		
SHT: Callout Text		1650
SHT: Detail Text		1651
SHT: Alignment Text		1652
SHT: Structure Text		1653
SHT: Utility Text		1654
SHT: Grid Marks and Text	Grid marks & grid text	1655
SHT: General Notes		1656
SHT: Title Block Text		1658
SHT: Misc Text		1659

Level Filter/Settings Group Name: Sheet

Level Name/Logical Name Prefix: SHT:

Level Number Range: 1600-1699

Section 6: Project Journal Files

Project Journal Guidelines

A Project Journal will be produced and delivered in accordance with the Engineering Technology Systems Manual. The purpose for this journal is to aid downstream customers of the CADD data so they may utilize existing CADD work in their processes. The journal will be an electronic file that will be included with the project data. The journal will contain the following information:

- A listing (Index) of the files delivered, including brief descriptions of each file in the directory structure and where the file is located.
- Documentation about the data (metadata) including major processes used, special CADD decisions made, exceptions to standards that were made, problems encountered and work around, or other important issues that arose during the course of the CADD work. For example, if a custom line style needed to be created, the justification, resource file, and files where that line style was used would be documented in the Journal. Other documentation such as the design software used, particular software settings, and other information that would help a downstream user of the data understand where and how the data was created should be documented.

UDOT has not established a specific format for the Journal / Index. UDOT allows 3 rd party tools that will help produce the Journal, provided the resulting file(s) for the Journal can be viewed/printed with tools on-hand, such as those found in the Microsoft Office® Suite or an internet browser.

Important data that should also be contained in the Journal include:

- All information necessary for the regeneration or use of those files by subsequent customers of the CADD data
- Document the geometry database, controlling alignment and profile names and geometry input/ output files, relevant survey information, cross sections and the methodology used to obtain the final geometric controls in the CADD product.

The project journal must be kept up to date as the CADD design work progresses and delivered with the project files for archival purposes. The creation, and maintenance of a project journal should be included with the project CADD QC plan.

Appendix A - Text Fonts

UDOT FONT LISTING	
FONT NAME	EXAMPLE
0 - STANDARD	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz Ø123456789
1 - WORKING	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
2 - FANCY	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
3 - ENGINEERING	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
7 - COMPRESSED	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
15 - IGES1001	ABCDEFGHIJKLMNOPQRSTUVWXYZ Ø123456789
16 - IGES1002	ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789
17 - IGES1003	ABCDEFGHIJKLMNOPQRSTUVWXYZ Ø123456789
23 - ITALICS	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *abcdefghijklmnopqrstuvwxyz* *0123456789*
26 - GREEK	ΑΒΧΔΕΘΓΗΙΚΛΜΝΟΠΞΡΣΤΥΦΩΧΨΖ αβχδεθγηικλμνοπξρστυφωχψζ ◇◇◇◇◇◇◇◇◇◇
30 - ISO_FONTLEFT	ABCDEFGHIJKLMNOPQRSTUVWXYZ ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789
31 - ISO_FONTRIGHT	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *ABCDEFGHIJKLMNOPQRSTUVWXYZ* *0123456789*
32 - INTL_ENGINEERING	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
33 - INTL_WORKING	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789

UDOT FONT LISTING

FONT NAME	EXAMPLE
41 - ARCHITECTURAL	ABCDEFGHI JKLMNOPQRSTUVWXYZ ABCDEFGHI JKLMNOPQRSTUVWXYZ 0123456789
42 - BLOCK_OUTLINE	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
43 - LOW_RES_FILLED	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
44 - LOW_RES_FILLED_BOLD	**ABCDEFGHIJKLMNOPQRSTUVWXYZ** **abcdefghijklmnopqrstuvwxyz** **0123456789**
50 - UPPERCASE	ABCDEFGHI JKLMNOPQRSTUVWXYZ ABCDEFGHI JKLMNOPQRSTUVWXYZ 0123456789
60 - FONT060	➤➤➤➤➤◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇ ➤➤➤➤➤◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇ ◇◇◇◇◇◇◇◇◇◇
90 - font090	◇◇✱⊛◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇ ◇◇✱⊛◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇ ◇◇◇◇◇◇◇◇◇◇
91 - font091	▶◆◆◆◆◇◇▭◆◆◆◆◆▭◆◆◆◆◆◆◆◆◆◆◆◇◇ ◇◆◆◆◇▦▦▦▦▦▦▦▦▦▦▦▦▦▦▦▦▦▦▦▦▦▦ ◆◆◇◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
92 - font092	◇◇○△⊞✕◆⊛⊠⊕◇◆◇◇◆◇◇◇⊠◇+□◭◇◇◇◇◇◇ ◇◇○△⊞✕◆⊛⊠⊕◇◆◇◇◆◇◇◇⊠◇+□◭◇◇◇◇◇◇ ◇◇◇◇◇◇◇◇◇◇
94 - font094	△△⊙⊙⊙⊙⊙⊙⊙⊙⊙△⊙⊙⊙℄H◇◇◇◇◇◇◇◇◇ △△⊙⊙⊙⊙⊙⊙⊙⊙⊙△⊙⊙⊙℄H◇◇◇◇◇◇◇◇◇ ◇◇◇◇◇◇◇◇◇◇
95 - font095	◓◓○◒◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇ ◓◓○◒◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇ ◇◇◇◇◇◇◇◇◇◇
100 - ANSI_SYMBOLS	ABCDEFGHI JKLMNOPQRSTUVWXYZ ∠—▱⌓◯//⌭↗I⊕◠⊥ⓂØ○Ⓟ↗◎ⓈⓁ⌴∨↧□Y◺ 0123456789
101 - FEATURE_CONTROL_SYMBOLS	ABCDEFGHI JKLMNOPQRSTUVWXYZ ∠—▱⌓◯//⌭↗I⊕◠⊥ⓂØ○Ⓟ↗◎ⓈⓁ⌴∨↧□YZ 0123456789
102 - SYMB_FAST	➢⟩▻▶▷≀Ø⇝➔•◇◇◇◇◇◇◇◇◇◇◇◇ ➢⟩▻▶▷≀Ø⇝➔•◇◇◇◇◇◇◇◇◇◇◇◇ ◇◇◇◇◇◇◇◇◇◇

UDOT FONT LISTING

FONT NAME	EXAMPLE
105 - INTL_ISO	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
106 - INTL_ISO_EQUAL	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
107 - INTL_ISO_ITALIC	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *abcdefghijklmnopqrstuvwxyz* *0123456789*
108 - INTL_ISO_ITALIC_EQUAL	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *abcdefghijklmnopqrstuvwxyz* *0123456789*
127 - CHAR_FAST_FONT	ABCDEFGHIJKLMNOPQRSTUVWXYZ ABCDEFGHIJKLMNOPQRSTUVWXYZ Ø123456789
128 - Times New Roman Bold	**ABCDEFGHIJKLMNOPQRSTUVWXYZ** **abcdefghijklmnopqrstuvwxyz** **0123456789**
151 - arial	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
158 - Times New Roman Bold Ital	***ABCDEFGHIJKLMNOPQRSTUVWXYZ*** ***abcdefghijklmnopqrstuvwxyz*** ***0123456789***
164 - Arial Italic	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *abcdefghijklmnopqrstuvwxyz* *0123456789*
171 - Courier Bold	**ABCDEFGHIJKLMNOPQRSTUVWXYZ** **abcdefghijklmnopqrstuvwxyz** **0123456789**
175 - Courier	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
177 - Arial Block	**ABCDEFGHIJKLMNOPQRSTUVWXYZ** **abcdefghijklmnopqrstuvwxyz** **0123456789**
190 - Times New Roman	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
196 - Courier Bold Italic	***ABCDEFGHIJKLMNOPQRSTUVWXYZ*** ***abcdefghijklmnopqrstuvwxyz*** ***0123456789***

UDOT FONT LISTING	
FONT NAME	EXAMPLE
203 - Times New Roman Italic	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *abcdefghijklmnopqrstuvwxyz* *0123456789*
211 - Courier Italic	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *abcdefghijklmnopqrstuvwxyz* *0123456789*
217 - Arial Bold	**ABCDEFGHIJKLMNOPQRSTUVWXYZ** **abcdefghijklmnopqrstuvwxyz** **0123456789**
247 - Arial Bold Italic	***ABCDEFGHIJKLMNOPQRSTUVWXYZ*** ***abcdefghijklmnopqrstuvwxyz*** ***0123456789***

Appendix B - Custom Linestyles

UDOT LINE STYLES	
EXAMPLE	LINE STYLE NAME
	(Border)
	(Center)
	(Dashdot)
	(Dashed)
	(Divide)
	(Dot)
	(Hidden)
	(Phantom)
CUT CUT	Breakline Cut
FILL FILL	Breakline Fill
	Breakline Structure 1
	Breakline Structure 2
	Breakline Structure 3
bc bc	Cable Buried Exist
BC BC	Cable Buried Prop
c c	Cable OH Exist
C C	Cable OH Prop
	Center 1
	Center 1 STR
	Center 2
	Center 2 STR
	Center 3
	Center 3 STR
	Center 4
	Center 4 STR
	Channel Lined
	Concrete 1 STR
	Concrete 2 STR

UDOT LINE STYLES

EXAMPLE	LINE STYLE NAME
	Concrete Boundary Struct
	Conduit Steel Exist
	Conduit Steel Prop
	Dash 1
	Dash 2
	Dash 3
	Dash 4
	Dash Double
	Depression
	Depression Dash
	Detector Circuit
	Dim Continuation
	Dim Inside Large
	Dim Inside Small
	Dim Outside Large
	Dim Outside Small
	Ditch Irrigation
	Ditch Unlined
	Ditch Waste
	Dot 1
	Dot 2
	Dot 3
	Double Dash 1 STR
	Double Dash 2 STR
	Double Line
	Double Line Dashed
	Drain Tile
	Elec Buried Exist
	Elec Buried Prop
	Elec OH Exist

UDOT LINE STYLES

EXAMPLE	LINE STYLE NAME
E E	Elec OH Prop
	Existing Pipe
	Fence
	Fence Link Exist
	Fence Link Prop
	Fence Link Structure
	Fence Wire Exist
	Fence Wire Prop
	Fence Wood Exist
	Fence Wood Prop
	Fenceline
fo fo	Fiber Optic Exist
FO FO	Fiber Optic Prop
	Flow Direction
g g	Gas Line Exist
G G	Gas Line Prop
	Ground Exist
	Guard Rail Exist
	Guard Rail Prop
	Hash 1
	Hash 2
	Hash Shade 1
	Hash Shade 2
ir ir	Irrigation Ag Exist
IR IR	Irrigation Ag Prop
	Leader Box Left
	Leader Box Right
	Leader Bubble
	Multiple Arrow
	Multiple Arrow Dash

UDOT LINE STYLES

EXAMPLE	LINE STYLE NAME
	Paint: Dotted
	Paint: Double Solid
	Paint: Lane Drop
	Paint: Perm Left
	Paint: Perm Right
	Paint: Skip
	Paint: Solid
	Paint: Solid 200
	Paint: Solid 300
	Paint: Temp Skip
	Paint: Xwalk
	Paint: Xwalk Ang
	Petro Prod Exist
	Petro Prod Prop
	Property Line
	R/W 40 Acre Line
	R/W Boundary1
	R/W Boundary2
	R/W Boundary3
	R/W Fence Exist1
	R/W Fence Exist2
	R/W LA/NA
	R/W Lot Line
	R/W PL
	R/W Property Line
	R/W QTR Sec Line
	R/W Railroad1
	R/W Railroad2
	Railroad 1
	Railroad 2

UDOT LINE STYLES

EXAMPLE	LINE STYLE NAME
	Railroad 3
	Riprap Large Below
	Riprap Large Centered
	Riprap Small Below
	Riprap Small Centered
	Road Comp Surface
	Road Graded Drained
	Road Gravel
	Road Gravel Graded
ss ss	San Sewer Exist
SS SS	San Sewer Prop
	Signal Circuit
sd sd	Storm Drain Exist
SD SD	Storm Drain Prop
	Stream Intermittent
bt bt	Tel Buried Exist
BT BT	Tel Buried Prop
t t	Tel OH Exist
T T	Tel OH Prop
	Tree Line
	Tree Line Dashed
	Wall Block Exist
	Wall Masonry
	Water Edge
w w	Water Line Exist
W W	Water Line Prop